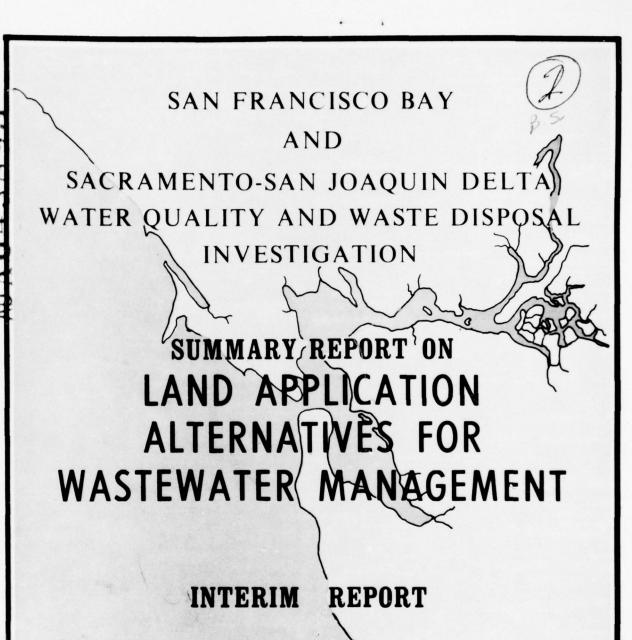
CORPS OF ENGINEERS SAN FRANCISCO CALIF SAN FRANCISCO--ETC F/G 13/2 LAND APPLICATION ALTERNATIVES FOR WASTEWATER MANAGEMENT FOR THE--ETC(U) AD-A043 893 MAR 75 UNCLASSIFIED NL OF3 AD AO43893





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MARCH 1975

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chard M. Connell

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SUBJECT: Interim Report - San Francisco Bay and Sacramento-San Joaquin Delta, Water Quality and Waste Disposal Investigation - Land Application Alternatives for Wastewater Management

DA, South Pacific Division, Corps of Engineers, 630 Sansome Street, Room 1216, San Francisco, California 94111 17 July 1975

TO: HQDA (DAEN-CWP-W) WASH DC 20314

I concur in the conclusions and recommendations of the District Engineer.

RICHARD M. CONNELL Brigadier General, U. S. Army Division Engineer

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SAN FRANCISCO BAY
AND
SACRAMENTO - SAN JOAQUIN DELTA
WATER QUALITY AND WASTE DISPOSAL
INVESTIGATION

SUMMARY REPORT

ON

LAND APPLICATION ALTERNATIVES FOR

WASTEWATER MANAGEMENT

for the

San Francisco Bay and Sacramento-San Joaquin
Delta Water Quality and Waste Disposal
Investigation.

Summary Report.

Alternatives for the State of California's Consideration in Comprehensive Water Quality Planning

INTERIM REPORT,

U.S. ARMY ENGINEER DISTRICT, SAN FRANCISCO

CORPS OF ENGINEERS

SAN FRANCISCO, CALIFORNIA

MARCH 1975

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ABSTRACT

THE STUDY

This report presents the results of a Corps of Engineers' effort in developing alternatives for the management of wastewater and sludge including wastewater reclamation alternatives, as related to the land treatment of wastes. Two regional wastewater management concepts incorporating land application, each including three separate alternatives for municipal and industrial discharges, are described and evaluated in terms of the objectives of national economic development, environmental quality, social well-being, and regional development. Land application techniques for treating wastewater offer a viable alternative means of meeting Federal and State water quality objectives and goals for many areas of the 12-county San Francisco Bay and Sacramento-San Joaquin Delta Region. Information presented will provide input to the State of California's water quality planning program, especially in the development of the State's "Comprehensive Water Quality Control Plans" for basins within the San Francisco Bay and Sacramento-San Joaquin Delta Region.

CONCLUSIONS

Concerning the feasibility of the development of land application alternatives for wastewater management on a regional basis:

- a. The development of land application alternatives for wastewater management on a regional basis is feasible and could produce an effluent comparable to tertiary treatment.
- b. The ultimate disposal of sludge could be accomplished through the use of land application.
- c. Through the use of land application, a valuable resource, reclaimed water, could be recovered and beneficially used for various enhancement purposes.
- d. No major socio-ecological or economic factors have been identified which would negate wastewater management by land application.

RECOMMENDATIONS

Based on the work accomplished in this study and its resultant conclusions, it is recommended that the Corps of Engineers:

a. Provide technical assistance to the State of California on land treatment systems for the disposal of municipal and industrial effluents, as requested, in completing and/or updating Comprehensive Water Quality Control Plans for basins within the San Francisco Bay and Sacramento-San Joaquin Delta Region;

- b. Continue and expand, under the original study authorization and in cooperation with the State of California and the Environmental Protection Agency, data collection and analysis of non-point sources pollution including urban stormwater runoff; and,
- C. Be authorized to prepare, in cooperation with the State of California and its local governmental agencies, subregional feasibility reports on land treatment of municipal, industrial, and non-point discharges in the 12-county San Francisco Bay and Sacramento-San Joaquin Delta Region with the objectives being consistent with comprehensive policies and plans for water quality.

SUMMARY REPORT ON LAND APPLICATION ALTERNATIVES FOR WASTEWATER MANAGEMENT

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1973 PUBLIC INFORMATION BROCHURE)

SUMMARY REPORT ON LAND APPLICATION ALTERNATIVES FOR WASTEWATER MANAGEMENT

INTRODUCTION

AUTHORITY

- 1. This study has been undertaken in partial response to various Congressional actions which directed the Corps of Engineer's involvement in water quality control, measures for waste disposal and wastewater management alternatives in the San Francisco Bav and Sacramento-San Joaquin Delta Region of California. The Corps' efforts in developing regional alternatives for the management of wastewater and sludge are summarized in this document. Numerous appendices support this summary report. Following are the specific authorities for this interim report:
- a. Sacramento, San Joaquin and Kern Rivers, California, Resolution, House Committee on Public Works, 8 May 1964:

"Resolved by the Committee on Public Works of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors is hereby requested to review the reports on Sacramento, San Joaquin and Kern Rivers, California, published as House Document 191, 73rd Congress, Second Session, and other reports with a view to determining the feasibility of remedial measures for water quality control and other purposes, included in comprehensive development of the Sacramento-San Joaquin Delta, including verification of conclusions by model analysis as deemed necessary," adopted 8 May 1964.

b. San Francisco Bay, California, Water Quality Control Study, Section 216 Flood Control Act of 1965 - PL 89-298:

"The Secretary of the Army is hereby authorized and directed to cause to be made, under the direction of the Chief of Engineers, an investigation and study of San Francisco Bav California, including San Pablo Bay, Suisum Bay, and other adjacent bavs and tributaries thereto, with a view toward determining the feasibility of, and extent of Federal interest in, measures for waste disposal and water quality control and allied purposes."

c. Resolution, House Committee on Public Works, November 1971:

"Resolved by the Committee on Public Works of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors is requested to determine the advisability of improvements in the interest of wastewater management and alternatives thereto, in the San Francisco Bay, California area, including San Pablo Bay, Suisun Bay, and other adjacent bays and tributaries thereto, in connection with investigations authorized for study of San Francisco Bay, California, by Section 216 of the Flood Control Act of 1965."

d. Committee Resolution, Senate Committee on Public Works, $23 \ \text{November} \ 1971:$

"Resolved by the Committee on Public Works of the United States Senate, that the Board of Engineers for Rivers and Harbors is requested to determine the advisability of improvements in the interest of wastewater management and alternatives thereto, in the San Francisco Bay, California area, including San Pablo Bay, Suisun Bay, and other adjacent bays and tributaries thereto, in connection with investigations authorized for a study of San Francisco Bay, California, by Section 216 of the Flood Control Act of 1965: and for Sacramento, San Joaquin and Kern Rivers, California by Resolution dated 8 May 1964 by the Committee on Public Works of the House of Representatives, United States. In carrying out the aforesaid investigation, the Board shall evaluate general alternatives for the management of wastewater on a regional basis, including the elimination of pollutant discharges and shall conduct such investigation with the participation, consultation and cooperation of the Environmental Protection Agency and State and local water pollution control agencies and, where appropriate, State and local agencies with environmental planning responsibilities."

INTERAGENCY AGREEMENT

2. On 8 March 1972 the California State Water Resources Control Board, Region LX of the Environmental Protection Agency and the U.S. Army Engineer District, San Francisco, executed a joint agreement for interagency water quality management planning assistance. As specified by the agreement, the Corps is to provide planning assistance to the State of California in the preparation of "Comprehensive Water Quality Control Plans" for basins

within the San Francisco Bay and Delta Region. In order to provide this planning assistance, four specific objectives were outlined in the "Joint Agreement" for study by the Corps of Engineers:

- a. Development of alternatives for treatment processes incorporating land application of wastewater:
- b. Development of alternatives for disposal of treatment system sludge by means of land application;
- c. Development of alternatives for wastewater reclamation and use as related to land application procedures; and,
- d. Evaluation of above alternatives in terms of the objectives of national economic development, environmental quality, social well-being, and regional development.
- 3. In addition, it was agreed that the Corps of Engineers would not directly address non-point sources of pollution such as urban storm water runoff and agricultural drainage in this wastewater management report. Also, the cities of San Francisco and Sacramento constitute the only sources of combined sanitary sewage and stormwater flow in the study area and since these excessive flows are under local study these combined flows were not included in the investigation.
- 4. Final alternatives developed in this report are comprised of combinations of land application components and conventional wastewater treatment plants. Conventional treatment components have been included since previous investigations have shown that the most viable systems of wastewater management involving land application would be a combination of both types of improvements. Consideration of conventional treatment components was also necessary to develop general data on sources and amounts of treatment system sludge which might be applied to land and to develop a range of full-system costs.
- 5. An all tertiary treatment system also is presented only for the purpose of providing a basis for cost comparison and to depict how the sludge from a complete water-oriented disposal scheme could ultimately be disposed of by land application if a tertiary treatment alternative were selected.

SOURCES OF DATA

6. Several investigations have been conducted by other agencies and organizations concerning various topics pertinent to this study. Subject topics ranged from land use and population growth to regional wastewater management plans as well as the future programs of the local municipalities, sanitary districts, and the Regional Water Quality Control Boards within the study area. Assistance on the technical aspects of wastewater management was obtained from

numerous published sources of Federal, State, and local agencies, and from various articles or papers available in the literature. Most of these data sources are on file at the San Francisco District Office, U.S. Army Corps of Engineers, 100 McAllister Street, San Francisco, California, 94102.

STUDY OBJECTIVES

- 7. When the Congress authorized the Corps of Engineers wastewater study, it did so with the understanding that the study would be conducted in the context of the State's requirements as well as those of other Federal agencies involved in water quality management. The Corps' role, then, is primarily one of assistance to the State, and not to conduct an independent investigation. The two objectives of this study, therefore, were: (a) to assist the State of California in the development of its Comprehensive Water Quality Control Plans for the San Francisco Bay and Sacramento—San Joaquin Delta Region; and, (b) to determine the feasibility of wastewater disposal oriented primarily to the use of land application as a renovation technique.
- 8. No specific alternative is recommended for adoption by the State. The function of the study has been to develop data and to analyze alternatives oriented toward land application of wastewater and sludge in order to assist the State in judging which method, or combination of methods, for the disposition, reuse or reclamation of wastewater is most suitable for adoption in the basins and subbasins of the 12-county Bay-Delta Region. The information generated from this study has been furnished to the State of California and the Environmental Protection Agency.

PARTICIPATION AND COORDINATION

Participation

9. Information and data presented in this report reflect the maximum use of previous study efforts by Federal, State of California, regional, and local agencies. In order to provide for the specialized expertise and local experience in engineering and environmental areas, several consulting firms provided technical input for this study under contract. A listing of these consulting firms is shown on the inside back cover.

Coordination

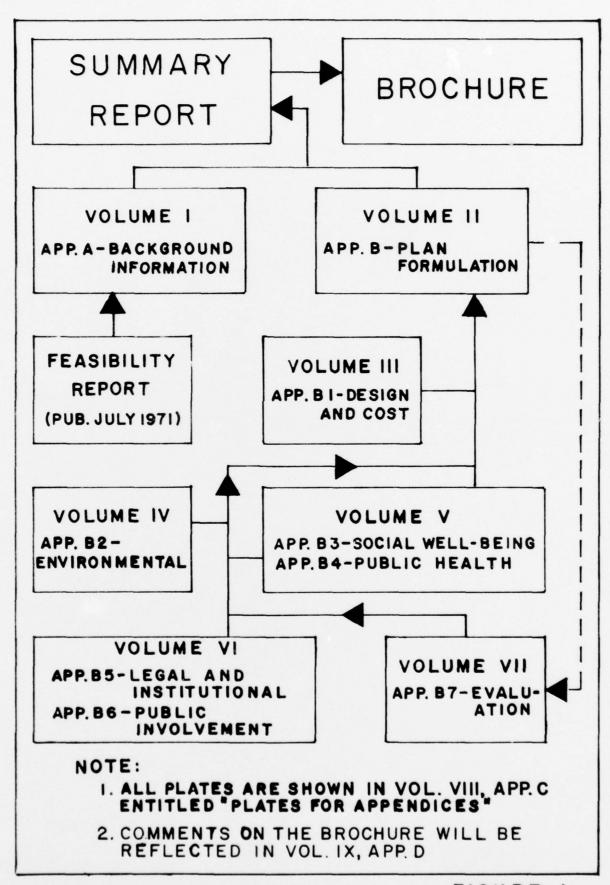
10. This study has been coordinated on a continuing basis with and has had active participation of Region IX of the Environmental Protection Agency, the State of California Water Resources Control Board, and the California Regional Water Quality Control Boards. During the conduct of this study, informational presentations were made to the San Francisco Bay Conservation and Development

Commission, the Association of Bay Area Governments, the Bay Area Sewage Services Agency, the San Francisco Bay Water Quality Group, the California Regional Water Control Boards. Several monitoring sessions on report development and progress were held with representatives of the Environmental Protection Agency and various State agencies. In addition, the public was informed of the Corps' study and assisted in its conduct by means of public meetings, workshops and through visits made by Corps personnel to individuals within the study area.

REPORT ARRANGEMENT

- 11. This interim report consists of a summary report and eleven appendices, bound in nine volumes, which are summarized below (see Figure 1):
- a. Vol. I, Appendix A Background Information. This appendix has as its basis an earlier report on wastewater management entitled "Alternatives for Managing Wastewater in the San Francisco Bay and Sacramento-San Joaquin Delta Area" prepared by the U.S. Army Corps of Engineers, San Francisco District in July 1971. This appendix contains all pertinent background information regarding the study.
- b. Vol. II, Appendix B Plan Formulation. This appendix summarizes the engineering, economic, environmental, social, and institutional information used for the development of wastewater management alternatives and their evaluation. Numerous secondary appendices support this appendix.
- c. Vol. III, Appendix Bl Design and Cost. This appendix presents the detailed engineering design data and concepts utilized to formulate the various wastewater and sludge management alternatives and their associated costs. Detailed cost estimates are presented in Attachment A to this appendix.
- d. Vol. IV, Appendix B2 Environmental. This appendix presents the environmental considerations in regard to the land application concept of wastewater management.
- e. Vol. V, Appendix B3 Social Well-Being. This appendix relates the social adjustments anticipated with regard to the wastewater management alternatives presented.
- f. Vol. V, Appendix B4 Public Health. This appendix presents the public health implications of the land application of wastewater and sludge.
- g. Vol. VI, Appendix B5 Legal and Institutional. This appendix summarizes the legal concerns and institutional arrangements with respect to various wastewater management alternatives.

- h. Vol. VI, Appendix B6 Public Involvement. This appendix summarizes the activities of the San Francisco District in involving the public and special interest groups in the wastewater management program.
- i. Vol. VII, Appendix B7 Evaluation. This appendix presents the environmental, social, economic and special considerations evaluation concepts for each of the wastewater management alternatives developed.
- j. Vol. VIII, Appendix C Plates for Appendices. This appendix furnishes all the plates developed for the study.
- k. Vol. IX, Appendix D Comments on the Brochure. This appendix reflects all comments received as a result of the public information brochure, "Land Application Alternatives for Wastewater Management" which was released in December 1973.



THE STUDY AREA

GENERAL CHARACTERISTICS OF THE AREA

- The study area in this report is located in west-central California and consists of the San Francisco Bay and Delta estuarine system and adjacent land areas covering 12 counties (Plate 1) with a total area of about 10,000 square miles. About 80 percent of the 12-county land area is tributary to the Bay and Delta estuarine system. The remaining 20 percent is comprised of portions of Marin. Sonoma, San Francisco, San Mateo and Santa Clara Counties which drain to the Pacific Ocean either directly or by way of streams not tributary to the Bay. The study area includes significant areas designated by the California State Water Resources Control Board as Basin Planning Areas. It includes the San Francisco Bay Basin, portions of planning basins in the Central Valley (Sacramento River, Sacramento - San Joaquin Delta, and San Joaquin) and areas within he North Coastal and Central Coastal Basins. The Basin Planning Areas designated by the State Water Resources Control Board are shown on Plate 2.
- 13. The San Francisco Bay system, consisting of San Francisco Bay proper, San Pablo Bay, Carquinez Strait and Suisun Bay, extends from the Golden Gate north about 30 miles and then east for about 20 miles to Pittsburg, and south about 40 miles to the vicinity of San Jose. The Bay's only connection with the ocean is through the Golden Gate. The San Francisco Bay drainage basin, as distinguished from the overall tributary area to the Bay, totals some 4,000 square miles, of which about 425 square miles are the Bay's water surface at mean high water. The Bay's shoreline is about 275 miles long at mean high water and contains substantial marshland areas.
- 14. The San Francisco Bay and Delta estuarine system and Pacific Ocean were divided into five water quality zones to permit differentiation of water quality in different parts of the system. These zones are:
- a. South San Francisco Bay southerly from San Francisco-Oakland Bridge to southern tip of the Bay.
- b. Central Bay the area north of San Francisco-Oakland Bridge, San Pablo Bay to Carquinez Bridge.
- c. Carquinez Strait Suisun Bay Carquinez Bridge to Chipps $\mbox{\sc Island.}$
- d. Sacramento-San Joaquin Delta a triangular region of about 1,100 square miles lying to the east of Chipps Island.
- e. Pacific Ocean Area The continental shelf extending about 30 miles westerly from the Golden Gate has a slope of about 23 feet per mile to the 100-fathom contour. The Farallon Islands are located

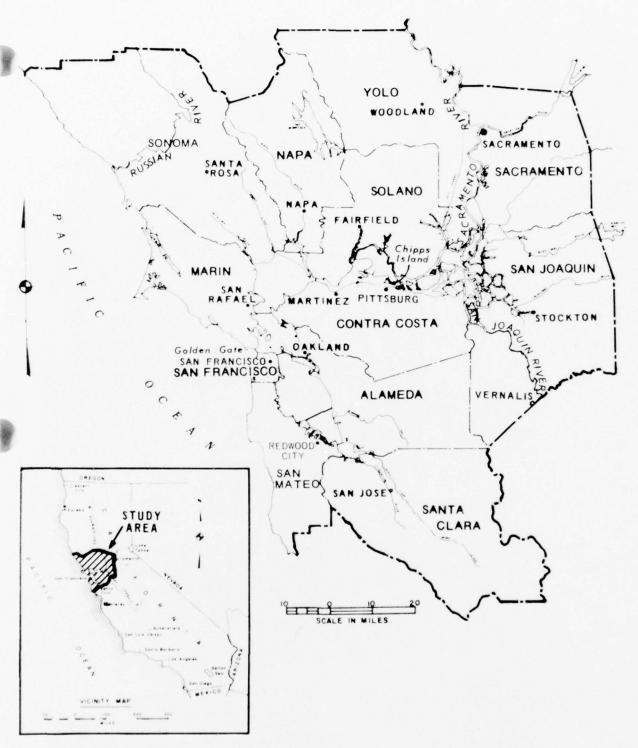
near the seaward limits of the shelf. Located on the shelf about eight miles west of the Golden Gate is a semi-circular bar whose elevation is 36 feet or less below mean sea level. The bar has been improved for deep-draft navigation by means of a channel dredged to an authorized depth of 55 feet.

15. Major municipal wastewater dischargers in the study area are listed in Table 1 and shown on Plate 3. These dischargers were designated as major municipal dischargers because of the population they serve, wastewater flows treated, and their relative geographic locations. Present municipal and industrial waste load data for the study area prior to treatment, as shown on Table 2, were compiled from various consulting engineer reports to the California Regional Water Quality Control Boards and to the U.S. Army Corps of Engineers.

GEOGRAPHY

Climate, Geology and Topography

- 16. There are wide contrasts in climate within short distances around San Francisco Bay. In San Francisco, sea fogs and low stratus cloudiness associated with them are characteristic of the climate. In the summer the temperature of the San Francisco Bay area is usually low near the coast and atmospheric pressure relatively high while the interior of California is characterized by the opposite in both elements. This tends to intensify the landward movement of air and to make the prevailing westerly winds brisk and persistent, especially from May to August. As a result of the steady sweep of air from the Pacific, there are few extremes of heat or cold. Pronounced wet and dry seasons are another characteristic of the climate. On the average, almost 85 percent of the total annual rainfall occurs between November and April. The climate of Oakland and other East Bay cities is similar to that of San Francisco, but daily mean temperatures are about four degrees higher at maximum and four degrees lower at minimum. Annual precipitation at Oakland Airport is about three inches less than San Francisco's 20.5 inches.
- 17. The Sacramento-San Joaquin Valley is characterized by warm dry summers and mild winters except for the highest altitudes. In the mountains the summers are warm and dry but winter temperatures fall below freezing frequently. The summer droughts are the result of a subtropical high pressure belt located off the coast which prevents summer rainfall. In winter, the high pressure area moves to the south and allows Pacific storms to move inland and deposit their moisture over the watershed. The centers of these storms usually pass over the basin area. The mild winter climate is due to the moderating effects of the Pacific Ocean on the one side and

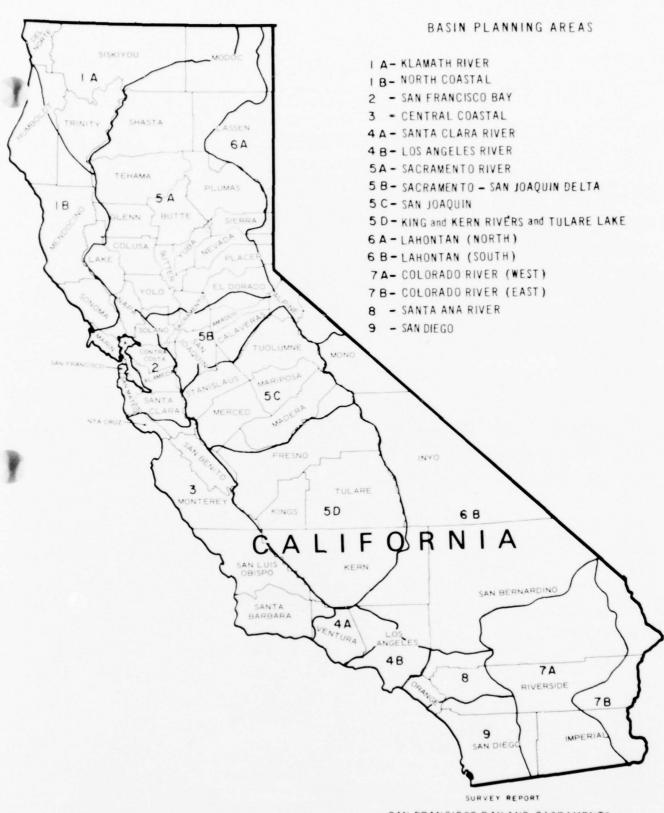


SURVEY REPORT

SAN FRANCISCO BAY AND SACRAMENTO -SAN JOAQUIN DELTA WASTEWATER MANAGEMENT STUDY

12 COUNTY STUDY AREA

U.S. ARMY ENGINEER DISTRICT, SAN FRANCISCO, CORPS OF ENGINEERS



SAN FRANCISCO BAY AND SACRAMENTO-SAN JOAQUIN DELTA WASTEWATER MANAGEMENT STUDY

BASIN PLANNING AREAS

	TABLE 1					
MAJOR	MUNICIPAL	WASTEWATER	DISCHARGERS			

IDENTIFICATION NUMBER		DISCHARGER
(1)	(2)	
		ALAMEDA COUNTY
AL01 AL02 AL03 AL04 AL05 AL06 AL07 AL08 AL09 AL10 AL11 AL11	2 03 025 2 03 037 2 LL 043 2 03 070 2 03 100 2 02 119a 2 LL 129 2 LL 130a 2 LL 016 2 01 119b 2 01 119c 2 LL 078	East Bay Municipal Utility Dist Special Dist. No. 1 City of Hayward City of Livermore Ora Loma Sanitary District City of San Leandro Union Sanitary District - Alvarado Valley Community Services District Veterans Administration Hospital - Livermore Castlewood Corporation Union Sanitary District - Irvington Union Sanitary District - Newark City of Pleasanton
		CONTRA COSTA COUNTY
CC01 CC02 CC03 CC04 CC05 CC06 CC07 CC08 CC09 CC10 CC11 CC13 CC14 CC15 CC16 CC17 CC18	2 08 004 2 08 019d 2 08 010 2 08 012 2 07 017 2 05 021 2 05 076 2 08 077b 2 94 082 2 05 086 2 05 103 2 05 038 2 06 019b 2 07 063 2 07 018 2 08 077a 2 08 069	City of Antioch Contra Costa County Sanitary District No. 15 Brentwood Sanitary District Byron Sanitary District Central Contra Costa Sanitary District Crockett - Valona Sanitary District City of Pinole City of Pittsburg - Camp Stoneman Plant City of Richmond Rodeo Sanitary District San Pablo Sanitary District Town of Hercules Contra Costa County Sanitary District No. 5 Mountain View Sanitary District City of Concord Contra Costa County Sanitary District No. 7A City of Pittsburg - Montezuma Plant Oakley Sanitary District
		MARIN COUNTY
MR01 MR02 MR03 MR04 MR05 MR06	2 10 164 2 05 036 2 05 040 2 04 057 2 04 081	Angel Island Bolinas Community Public Utility District Hamilton Air Force Base Las Gallinas Valley Sanitary District City of Mill Valley Richardson Bay Sanitary District 1 of 5

TABLE 1 (CONT'D) MAJOR MUNICIPAL WASTEWATER DISCHARGERS

	IDENTIFICATION NUMBER DISCHARGER			
(1)			DISCHARGER	
MR10 MR11 MR12 MR13 MR14 MR15 MR16	2 LL 1 2 04 0 2 04 0 2 05 0 2 05 1 2 04 1 2 10 1 2 05 1 2 05 0 2 05 0	050 051 052b 104a 106 - 115 104b	Mill Valley Air Force Base Marin County Sanitary District No. 1 Marin County Sanitary District No. 5 Marin County Sanitary District No. 6 - Novato San Rafael Sanitary District - Main Plant Sausalito - Marin City Sanitary District Stinson Beach Tomales Sewer Maintenance District San Rafael Sanitary District - Marin Bay Plant Marin County Sanitary District No. 6 - Bahia Marin County Sanitary District No. 6 - Ignacio	
			NAPA COUNTY	
NPO1 NPO2 NPO3 NPO4 NPO5 NPO6 NPO7 NPO8	2 05 0 2 05 0 2 05 0 2 LL 0 2 05 0 2 LL 0 2 05 0	015 064 071 091 131	American Canyon County Water District City of Callistoga Napa County Sanitation District Pacific Union College City of Saint Helena Veterans Home of Yountville Napa Valley Mobile Home Park Meadowood Development Company	
			SACRAMENTO COUNTY	
\$T01 \$T02 \$T03 \$\$104 \$T05 \$T06 \$T08 \$T09 \$T10 \$T11 \$T12 \$T13 \$T14 \$T15 \$T16 \$T17 \$T18 \$T19	5A 34 (5A	048 013 007 011 009 047 042 008 007 003 002 033 049 028 010	Sacramento Metropolitan Airport Sacramento County Central Sanitation District City of Folsom City of Galt City of Isleton Natomas County Sanitation District City of Sacramento - Main Plant Sacramento Signal Depot City of Walnut Grove Rio Linda County Water District Linwood Sewer Maintenance District Highlands Sanitary District Arden Sanitation District McClellan Air Force Base Northeast County Sanitation District Sacramento County Sanitation District Sacramento County Sanitation District Cordova Sanitary District Arden Gold Sanitary District	
ST21	5A 34	014	Folsom Prison	2 of 5

TABLE 1(CONT'D)

MAJOR MUNICIPAL WASTEWATER DISCHARGERS

1	TIFICATION UMBER	DISCHARGER	
(1)	(2)		
ST23 ST24	3A 34 051 5A 34 011 5A 34 031 5A 34 050	City of Sacramento - Meadowview Plant Manlove Sewer Maintenance District Mather Air Force Ease Elk Grove Sanitary District	
		CITY AND COUNTY OF SAN FRANCISCO	
SF03 SF04 SF05	2 04 140a 2 10 140b 2 04 140c 2 04 125a 2 03 125b	San Francisco - North Point Plant San Francisco - Richmond Sunset Plant San Francisco - Southeast Plant U.S.N. Treasure Island U.S.N. Yerba Buena Island	
		SAN JOAQUIN COUNTY	
SJ02 SJ03 SJ04 SJ05 SJ07 SJ08 SJ09 SJ10 SJ11	5B 39 055 5C 39 011 5B 39 017 5B 39 025 5C 39 048 5C 39 001 5B 39 040 5B 39 050 5B 39 033 5B 39 030 5B 39 007 5C 39 003	Deuel Vocational Institute City of Escalon Lockeford Sanitary District City of Lodi City of Manteca & Lathrop County Water District Sharpe Army Depot City of Stockton - Main Plant City of Tracy City of Stockton - Northwest Plant Lincoln Village Sanitary District Woodbridge Sanitary District Raymus Village SAN MATEO COUNTY	
SM01 SM02 SM03 SM04 SM05 SM05 SM07 SM08 SM09 SM10 SM11 SM12 SM13 SM14	2 02 094 2 03 011 2 03 028 2 03 035 2 10 177 2 02 056 2 03 058 2 10 072b 2 02 080 2 10 072a 2 03 102 2 03 110 2 10 060	Cities of San Carlos and Belmont City of Burlingame Estero Municipal Improvement District Guadalupe Valley Municipal Improvement District Half Moon Bay Sanitary District Menlo Park Sanitary District City of Millbrae North San Mateo County Sanitation District City of Pacifica - Linda Mar Plant City of Redwood City (including Redwood Shores) City of Pacifica - Sharp Park Plant City of San Mateo Cities of South San Francisco and San Bruno Montara Sanitary District 3 of 5	

TABLE 1 (CONT'D)

MAJOR MUNICIPAL WASTEWATER DISCHARGERS

1	NUMBER DISCHARGER		
(1)	(2)		
	2 03 096a 2 10 034	San Francisco International Airport Granada Sanitary District	
		SANTA CLARA COUNTY	
SC01 SC02 SC03 SC04 SC05 SC06 SC07 SC08	2 01 113 2 01 074 2 01 062 2 01 046 2 01 059	Cities of Gilroy and Morgan Hill City of San Jose City of Sunnyvale City of Palo Alto City of Mountain View City of Los Altos Milpitas Sanitary District City of Alviso	
10000	01 002	SOLANO COUNTY	
SL02 SL03 SL04 SL05 SL06 SL07	2 06 009 5A 48 024 2 07 029 2 05 124 3B 48 009 2 48 005 2 05 128 5B 07 117	City of Benecia City of Dixon Fairfield - Suisun Sewer District U.S.N. Mare Island City of Rio Vista City of Vacaville - Elmira Plant Vallejo Sanitation and Flood Control District Travis Air Force Base Vacaville Medical Facility	
SL11	5B 48 004	City of Vacaville - Brown St. Plant	
		SONOMA COUNTY	
\$N03 \$N04 \$N05 \$N06 \$N07 \$N08 \$N09 \$N10 \$N11 \$N12 \$N13	IB 49 060 15 49 056 1B 49 059 IB 49 071	Russian River County Sanitation District City of Cloverdale Fdrestville County Sanitation District Sonoma County Airport Stewards Training and Recreation Inc. City of Healdsburg Los Guilicos School Windsor County Water District City of Santa Rosa - Oakmont Plant City of Santa Rosa - College Avenue Plant City of Santa Rosa - Laguna Plant City of Sebastopal	
	1B 49 066 JB 49 061	Bodega Bay Public Utility District Occidental County Sanitation District 4 of 5	

TABLE 1 (CONT'D) MAJOR MUNICIPAL WASTEWATER DISCHARGERS

IDENTIFICATION NUMBER		DISCHARGER	
(1)	(2)		
SN17 SN18 SN19 SN20	1B 49 062 2 05 025 2 05 109 2 05 123	Cities of Rohnert Park and Cotati City of Petaluma Sonoma Valley County Sanitation District U.S.N. Skaggs Island	
		YOLO COUNTY	
YL01 YL02 YL03 YL04 YL05 YL06 YL07 YL08 YL09	5A 57 020 5A 57 024 5A 57 019 5B 57 003 5A 57 017 5A 57 013 5A 57 008 5A 57 009 5A 57 002	City of Davis El Macero Sewer Maintenance District University of California at Davis West Sactamento Sanitary District City of Winters City of Woodland Esparto Sanitary District Madison Service District Knights Landing Service District	
			5 of 5

- (1) As used in this report.
- (2) As used by the State Water Resources Control Board in "Interim Water Quality Control Plans," dated June 1971.
- Not identified.

TABLE 2

MUNICIPAL AND INDUSTRIAL LOADINGS - 1972

County	FLOW (MGD)	BOD	TDS	TN	TP	GН М −Т
Alameda	162.4	307.8	929.8	44.7	17.5	12.8
Contra Costa	198.0	317.3	1,210.8	64.2	12.7	5.9
Marin	22.0	42.7	126.5	5.3	2.5	2.3
Napa	19.4	29.4	139.7	5.9	3.7	5.1
Sacramento	111.4	294.5	647.4	32.0	12.0	8.1
San Francisco	107.6	232.7	631.3	31.6	12.3	5.8
San Joaquin	74.2	188.7	410.8	18.6	6.8	12.7
San Mateo	66.9	143.1	386.1	17.2	7.0	4.5
Santa Clara	149.2	377.7	861.5	43.7	16.3	20.4
Solano	30.2	76.2	167.8	8.7	3.1	3.4
Sonoma	21.5	59.4	117.5	6.1	2.1	3.0
Yolo	23.9	59.9	114.1	5.2	1.8	7.9
TOTALS	986.7	2,129.4	5,743.3	283.2	97.8	91.9

All values except flow are reported as 1,000 lbs/day.

CHM-T (Gross Heavy Metals - Total) includes: Arsenic, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Mercury, Molybdenum, Nickel and Zinc.

BOD (Biochemical Oxygen Demand) is the amount of oxygen required to decompose organic compounds to stable substances.

TDS (Total Dissolved Solids) is that quantity of mineral matter contained in wastewater in a dissolved state.

TN (Total Nitrogen) is the total quantity of nitrogen present in the form of ammonia, organic, nitrite, and nitrate-nitrogen.

TP (Total Phosphorus) is the total quantity of phosphorus present in the form of orthophosphates, condensed phosphates, and organic phosphates. of the high barrier of the Sierra Nevada range which protects the basin from the cold air masses of the interior on the other side. The valley floor is free of frost during the growing season with the average frost-free period being more than seven and one-half months. The valley floor has an average of 15 days when the minimum temperatures fall below 32 degrees F. Maximum temperatures in the summer, however, will exceed 100 degrees F. on an average of 15 days each year and exceed 90 degrees F. about 45 days of each year. Relative humidities in summer vary from about 36 percent to 89 percent.

- 18. The 12-county area encompasses parts of two geomorphic provinces of California, the Coast Ranges and the Great Valley. Each province is characterized by distinctive natural topographical and geological features. The Coast Ranges comprise a series of nearly parallel mountain ranges and valleys that trend in a northwesterly direction and rise to elevations of over 4,000 feet. This trend is largely controlled by the geologic structure in the underlying rocks which is dominated by the active San Andreas Fault system running nearly the full length of the Coast Ranges. In contrast, the Great Valley consists of a central, comparatively flat alluvial plain, about 400 miles long and 50 miles wide, lying between the Coast Ranges and the Sierra Nevada range to the east. Elevations in the Great Valley, with few exceptions, range from sea level to 100 feet. The valley is drained by the Sacramento and San Joaquin Rivers, which join in the Delta area before entering San Francisco Bay. The southernmost part of the Great Valley, the Tulare Lake Basin, is an interior drainage basin with no direct drainage to the sea. It is separated from other portions of the San Joaquin Valley by a very low divide.
- 19. The Sacramento and San Joaquin River sub-basins (including Tulare Lake Basin) drain about one-third of the area of California. The two rivers are the principal source of fresh water and are the primary means by which agricultural wastewaters are carried from the Central Valley. Prior to any development by man in the Central Valley, the natural outflow through the Delta, in a normal water year, was about 30 million acre-feet. Because of water use within the Central Valley and net exports from its basin, the present average Delta outflow is about 18 million acre-feet per year. As water use in the Central Valley increases and exports from the basin grow, it has been estimated that the net Delta outflow may be as low as seven million acre-feet in year 2020. The greater part of municipal and industrial wastewaters analyzed in this report derive from fresh waters that are introduced into the 12-county area as water supply diversions from the headwaters of the two river basins.
- 20. Local streams draining into San Francisco Bay have a combined mean annual discharge of about 450,000 acre-feet. The mean normal annual precipitation over the Bay's local drainage area is 19 inches. The mean annual evaporation over the entire Bay system is about 48 inches.

21. The mean range of tide at the Golden Gate is about five feet, with a mean tidal prism in the Bay of about 1.2 million acre-feet. The total water volume at mean high tide in the Bay system is about 5.5 million acre-feet. Thus, the mean tidal prism is about 21 percent of the total volume of water in the Bay.

NATURAL RESCURCES

- 22. The major natural resource of the San Francisco Bay-Delta Region is its continuous waterways which serve a major role in the areas commercial and manufacturing growth. Petroleum, natural gas, sand, and gravel are the items most economically significant of the mineral resources of the area. Other valuable resources include mercury, salt, sulphur and peat.
- 23. Other important natural resources in the study area are: the fertile productive lands, sustaining an agricultural output valued at 500 million dollars per year: important fish and wildlife areas in which sport fishing is a major recreational use of San Francisco Bay-Delta waters; and the marshlands of the Bay and Delta which are important to the migratory birds using the Pacific Flyway.

DEMOGRAPHY AND CULTURE

- 24. The population of the 12-county study area has tripled over the past 40 years, with approximately 60 percent of the increase occurring in the last 20 years. The growth rate of the 12-county study area over the last 20 years has lagged slightly behind that for the entire State. However, several counties within the study area have experienced over 100 percent growth in the last 20 years (Table 3). The principal cities shown on Table 3 represent those cities which had a population in excess of 100,000 during the year 1970.
- 25. The professional, technical, and managerial fields were the largest occupation group in the study area in 1970; over 614,000 people or 28 percent of all people employed worked in this group. Clerical and kindred workers were the second largest occupational grouping; 21.5 percent were employed. People in farming occupations were the smallest grouping, only 1.4 percent were employed in this group.

LAND USE

26. The present land use character of the study area indicates a diversity of elements hardly matched by any other region of the country. Such an evolution to its present status can be seen in to ms of these distinct development periods:

TABLE 3

1970 POPULATION OF THE 12 COUNTIES IN STUDY AREA AND THE PRINCIPAL CITIES 1/

County	Growth Rate 1950-1970 <u>2</u> /	County Population	Principal City	Principal City Population
Alameda	1.45	1,073,000	Oakland	362,000
Contra Costa	1.86	558,000		
Marin	2.40	206,000		
Napa	1.70	79,000		
Sacramento	2.25	631,000	Sacramento	254,000
San Francisco	.90	716,000	San Francisco	716,000
San Joaquin	1.45	290,000	Stockton	108,000
San Mateo	2.35	556,000		
Santa Clara	3.65	1,065,000	San Jose	444,000
Solano	1.60	170,000		
Sonoma	1.95	205,000		
Yolo	2.20	92,000		
Total		5,641,000		

^{1/} Bureau of Census figures to nearest thousand.

^{2/} California growth rate, 1950-1970 = 1.85 (Bureau of Census). Growth rate defined as 1970 population + 1950 population.

- a. The Gold Rush of the mid-1800's,
- b. The introduction of rail transportation in the late 1800's, and
- c. The events of national and international importance, such as the wars and space exploration from early $1900\,\mathrm{'s}$ to today.

As a result, petroleum, communications, shipping and transportation, tinance and commerce, aerospace, military, research, electronics, government, manufacturing, and agribusiness, among other economic factions, have all helped to create the current "dynamism" of the study area.

27. In the study area growth and development of the urbanized areas generally followed the bay shoreline, directed largely by the constraints of the terrain, provision of transportation facilities, and the location of important economic and service activities. Sacramento grew outward from the core, generally in a southerly direction at first, but more recently to the northeast. By and large, the pattern of urban land consumption was predictable and evolved in a natural and logical manner. Growth was forced along clearly delineated flat areas and transportation systems. The most urbanized counties in terms of area are: San Francisco (70 percent), San Mateo (20 percent), Contra Costa (20 percent) and Alameda (20 percent). The least urbanized in area are: Sonoma and Napa (both slightly over 2 percent), Yolo (3 percent) and Solano (3.5 percent).

ECONOMIC ACTIVITY

- 28. Total employment for the study area was about 2,363,000 for 1970. Government and service employment are the largest and fastest growing employment groups in the study region with employment of 500,000 and 498,000, respectively. The financial industry centered in San Francisco also has experienced rapid growth.
- 29. Employment in agriculture has declined in the last five years. Increased efficiency in farm technology has outpaced the growth in demand of agricultural products leading to the long-term decline in agricultural employment. Despite employment declines, agriculture is a very important industry for the area. For example, the Sacramento Valley is a leading producer of fruits, nuts, and field crops and Napa Valley produces some of the best premium California table wines.
- 30. During 1970, manufacturing employment averaged 388,000. One of the largest industries in manufacturing is the electric machinery industry with 66,000 in employment. Wholesale and retail trade constituted about 484,000 in employment in 1970. San Francisco County had the largest trade employment.

STUDY AREA IN THE FUTURE

FACTORS AFFECTING FUTURE GROWTH

31. The area's economic growth will continue to depend upon a combination of internal and external factors. The region has an expansive, diversified and wealthy market. To the extent that the region maintains a desirable living environment, a well educated and productive labor force, and continues to be a favorable location for investment, it can be expected to grow at a fast pace.

POPULATION PROJECTIONS

32. Two population projections were considered in this study. The first was the Series D-150 developed by the California Department of Finance. These values are the population levels generally utilized by the State of California for basin planning. Therefore, this study was also based on the same population data. The second projection was the E-O series, also developed by the California Department of Finance. The E-O series is of interest to many agencies and segments of the public as a frame of reference for future planning. Grant regulations of the State Water Resources Control Board for wastewater treatment facilities make use of these projections in critical air basins. Also, the E-O series is used for planning in critical air basins as discussed later in this report. Table 4 shows the Series D-150 and Series E-0 population projections for the counties within tle study area. With the Series 0-150 projections, the population of the study area can be expected to increase from a 1975 population of about 6.1 million people to 9.2 million in 2000, an approximate increase of 51 percent, and with the Series E-O projections, the population of the study area can be expected to increase from about 6.0 million people in 1975 to 7.6 million in 2000.

PROJECTED LAND USE - 2000

- 33. While for the purpose of this report other projections are carried to the year 2020, land use, relying on independent projections are carried only to the year 2000. The shorter time span is due to the interdependence and complexities associated with land use projections.
- 34. The 12 counties of the study area are projected to have a total population of over 9.2 million people by 2000 7.5 plus million in the Bay region (9 counties) and 1.7 million in the Delta (3 counties). Distribution and characteristics of future development will depend on location of employment, accessibility of jobs to residential areas, large-scale planned housing schemes, environmental concerns, and planning controls, regarding both location and intensity of land uses. Most industries will grow faster outside the more densely developed and stabilized core areas. As this fanning out process continues, a substantial decentralization of the study area economy will occur. Except for occasional instances, real dispersal or recentralization is unlikely. Much

TABLE 4

COMPARISON OF POPULATION PROJECTIONS 1/

County	19	75	19	080	19	90	20	000
	Series D-150	Series E-0	Series D-150	Series E-0	Series D-150	Series E-0	Series D-150	Series E-0
Alameda	1,140	1,100	1,200	1,150	1,380	1,220	1,510	1,275
Contra								
Costa	615	605	690	650	850	735	990	790
Marin	230	222	262	242	336	285	403	322
Napa	88	88	103	96	147	114	193	127
Sacrament	o 683	683	741	728	865	818	972	883
Sim								
Francisco	710	710	720	710	730	705	725	690
San								
Joaquin	315	313	340	332	394	368	446	400
San Matec	580	560	615 .	570	675	580	720	575
Santa								
Clara	1,220	1,185	1,385	1,305	1,76	1,560	2,105	1,765
Solano	188	188	214	212	303	262	421	305
Sonom	235	232	275	257	371	308	481	356
Yo1o	104	102	119	113	156	137	194	160
Toral	6,108	5,188	6.684	6.365	7,967	7,092	9,160	7,648

^{1/} Data from California Department of Finance with values reported as thousands of persons.

of the available "skipped over" land within urban metropolitan areas will be filled in. Densities will probably increase in urban centers and along transportation corridors; e.g., BART (Bay Area Rapid Transit System). By and large, future development will be characterized by more compact groupings and intense land utilization.

- 35. The majority of new employment and industrial opportunities (urbanization) is expected to occur as an expansion of already existing centers. It appears that areas particularly favored by absolute expansion potential are: South Bay (San Jose area), Central Contra Costa County, Southeast Bay (Fremont area), Central Alameda County, and Sacramento metropolitan area. Likewise, areas forecast for greater proportion of growth increase are the smaller (in population) counties: Sonoma, Napa, Marin and Yolo. Particular expansion is also projected for the Pittsburg-Antioch area (Contra Costa County) and areas adjacent to the San Francisco and Oakland Airports. San Francisco City and County will continue to retain its position as the center for finance and commerce. Sacramento County will increase its role as a governmental and service center. San Jose metropolitan area will show the greatest growth in economic diversity and as an area of increased importance as an urban center. It appears that the density in terms of population per overall urban metropolitan areas will be stabilized in the immediate future and start to increase again within a decade or so.
- 36. Based on Series D-150 projections, the population density is forecasted to reach about 1.4 persons per acre, or over 890 persons per square mile by 2000. This represents an increase of about 0.5 persons per acre, or over 350 persons per square mile. The projected basic land use absorption is as follows:

Urban/Developed 1,065,800 acres
Residential (600,400 acres)
Streets/Highways (221,700 acres)
Commerce/Industry/Other Urban (243,700 acres)

Undeveloped and Agriculture

5,597,700 acres

Total Acres

6,663,500 acres

The total proportion of urbanized land of the study area is projected to increase by almost 7 percent, from 9.2 percent to 15.9 percent by the year 2000. This amounts to a net conversion increase of almost 450,000 acres. During this period, the proportion of residential usage to remaining developed land is expected to increase from almost 50 percent to 56 percent.

ECONOMIC ACTIVITY

- 37. Based on California Framework Study assumptions on economic growth in the area, it is estimated that industrial employment in the study area will increase from 2,362,800 to 5,059,000 by 2020. Manufacturing employment a expected to double by 2020. Wholesale and retail trade employment can be expected to increase 600,000 people by 2020. The following manufacturing groups require large quantities of water in their operation and have large waste loads:
- a. Oil Refineries Based on a predicted increase in per capita consumption of refined petroleum products from the present 31 barrels per year to about 75 barrels per year in 2020 and assuming an available supply, the total annual production of refineries located in the study area will probably increase from 170 million barrels per year to some 1 billion barrels per year in 2020, an annual growth rate of about 3-1/2 percent.
- b. Paper and Allied Products This industrial group manufactures about 2,000 tons per day of paper products. In the next 50 years, production is projected to increase to about 12,000 tons per day. Employment in this industry is expected to more than double by 2020.
- c. Canning Canning production is expected to increase at a rate of about three percent annually. Employment within the food and kindred products industry is expected to decrease slightly by 2020. There will be about 59,600 people employed in this industry by 2020 in the study area.
- d. Chemicals Production of chemicals in the study area is expected to grow 11-fold in the period of 1970-2020. The expected increase in petroleum refining in the study area would contribute to an expansion of petro-chemical production. Employment in the chemical industry is expected to double by 2020.
- e. Steel Within the study area, industrial steel products are anticipated to increase in annual consumption from 2.2 million tons to 11 million tons and product manufacturing is expected to increase from 600,000 tons to 12 million tons per year. The Primary Metals industry employment is expected to increase by 50 percent.
- f. Agriculture It is estimated that by the year 2020, the amount of land used for irrigated agriculture in the nine Bay Area counties will be 416,000 acres, a reduction of some 15 percent from 1967. By 2020, irrigated land in the Delta (Yolo, Sacramento and San Joaquin Counties) is expected to increase by some 15 to 20 percent to 1.55 million acres. In the Central Valley tributary to the 12-county area, including Tulare Lake Basin, it is estimated that about seven million acres will be under irrigation by 2020.

WASTE LOADS

- 38. Using the established population projections, future wastewater flows and constituents were estimated. Municipal wastewater flows were projected for dry weather flows only and include those flows generated by sanitary systems in residential dwellings and commercial establishments. It represents wastewater flows generated in connection with people rather than products. Existing dry weather wastewater flows for each municipal discharger or service area were obtained from data of the California Regional Water Quality Control Boards and from local and subregional reports. Dry weather flows were selected since it was assumed that infiltration would be removed from collection systems by local corrective action over the study period. Based on population estimates and industrial development in the service areas, wastewater flows were modified to exclude those flows which should more properly be included in industrial wastewaters. The municipal flows were corrected to the year 1970, which was used as a population projection base year for the design data.
- 39. The 1970 flow for each discharger was multiplied by a growth factor which is the ratio of the county population in any desired year to the 1970 county population to obtain flows in future years. Growth factors are shown in Table 5 and the resultant initial municipal flows are presented, by county, in Table 6.
- 40. The wastewater constituents developed were based on data presented in the various subregional reports to the California Regional Water Quality Control Boards. Data were developed on a milligram per liter (mg/1) basis for each county and flow-weighted to obtain a county average. The initial municipal county constituent loadings assumed a BOD of 200 mg/1, TN of 27 mg/1, TP of 11 mg/1, GHM of 3.5 mg/1, and TDS of 550 mg/1. These values were assumed to be constant over time because they were the best data initially available.
- 41. Each discrete industry with a known existing process wastewater discharge was identified from the various subregional reports, Regional Water Quality Control Board reports, and the U.S. Army Corps of Engineers' Form 4345-1 (Application for Permit to Discharge or Work in Navigable Waters and their Tributaries). For all industries, data were utilized to obtain a process flow increase factor. This factor was then applied to the existing flows to obtain the 1975 and 2000 process flows. The existing flows were obtained from the same sources as were used to identify the existing discrete industries. Only those industries which discharge 0.01 MGD or greater effluents were considered. Table 7 presents the initial industrial wastewater flows.

REGIONAL PLANNING GOALS AND OBJECTIVES

Introduction

42. Regional planning goals are essential in establishing a planning framework since such goals guide the thrust of an entire planning effort. They are ends toward which individual policies, programs

TABLE 5
POPULATION PROJECTION GROWTH FACTORS

COUNTY		STU	JDY YEAR	
	1970	1975	2000	2020
Alameda	- 1	1.053	1.397	1.678
Contra Costa	- 100	1.093	1.792	2.330
Marin	-	1.116	1.941	2.670
Napa	-	1.139	2.531	3.797
Sacramento	-	1.061	1.584	1.902
San Francisco	-	1.068	1.047	1.117
San Joaquin	-	1.068	1.724	2.069
San Mateo	-	1.043	1.258	1.439
Santa Clara	-	1.145	1.971	2.723
Solano	-	1.117	2.352	4.706
Sonoma	-	1.170	2.439	3.415
Yolo	<u>.</u>	1.195	2.173	3.261

TABLE 6

PROJECTED MUNICIPAL WASTEWATER FLOWS 1/

COUNTY		I	FLOW/YEAR (MG	D)
	1970	1975	2000	2020
Alameda	132	140	185	222
Contra Costa	59	65	109	141
Marin	20	22	38	53
Napa	8	9	20	30
Sacramento	94	100	149	179
San Francisco	102	103	107	115
San Joaquin	52	56	90	108
San Mateo	52	54	65	75
Santa Clara	122	140	241	332
Solano	21	24	51	102
Sonoma	16	18	39	54
Yo1o	12	15	27	41
Total	690	746	1,121	1,452

^{1/} Initial Data.

COUNTY	FLOW/YEAR	(MGD)
	1975	2000
Alameda	14.0	31.4
Contra Costa	143.2	294.3
Marin	1.0	2.3
Napa	0.7	1.5
Sacramento	0.6	1.3
San Francisco	0.04	0.09
San Joaquin	12.6	27.9
San Mateo	3.9	9.4
Santa Clara	2.4	2.6
Solano	4.4	10.3
Sonoma	0	0
Yolo	3.2	2.6
Total	186.04	383.69

^{1/} Initial Data.

and efforts may be directed. They include a large measure of idealism, for they present in a broad manner and in words that which the region considers to be ultimately desirable.

43. Most regional goals can be defined by sets of regional objectives which serve as the basis for the actual formulation, design and evaluation of a plan or project. Regional objectives differ from regional goals in that they are more tangible and usually reflect a condition which is immediately attainable by controlling real parameters such as chemical and/or physical factors, ecological associations and recreation in the case of environmental considerations; public attitudes and public health in the case of social considerations; and costs and benefits in the case of economic aspects. By meeting regional objectives, the planning goals of a region may be achieved wholly or in part.

Regional Planning Goals

- 44. Regional planning goals have been established by nearly every planning agency in the San Francisco Bay-Delta Region. From the plans and policies of State, regional and local planning agencies, the following regional planning goals have been identified by the Corps of Engineers for this study of wastewater management in the San Francisco Bay and Sacramento-San Joaquin Delta Region:
- a. Protect and enhance the major physical features and environmental qualities of the area.
- b. Provide the opportunity for all persons in the area to obtain adequate shelter convenient to other activities and facilities, in neighborhoods that are satisfying to them.
- c. Provide ample land and facilities, and develop a strong, diversified economic base, for the economic distribution and growth of the area in order to allow opportunities for all citizens and communities to improve their economic well-being.
- d. Create a sense of regional identity, responsibility, and cooperation among citizens, organizations, and governments in the area.
- e. Promote the distinctive character and identity of the area and of its parts.
- f. Provide all residents with opportunities for a wide range of cultural, social, educational, health and commercial activities and facilities.

Regional Planning Objectives

45. Using the identified regional planning goals, objectives have been formulated for the San Francisco Bay-Delta Region. Certain of these objectives are included in published reports of other agencies. Others have been developed by the Corps.

- a. Maintain and enhance to the highest possible levels the quality of all waters in the region.
- b. Protect all waters in the region from adverse water quality factors.
- c. Protect and enhance aquatic life and associated wildlife in streams, rivers, estuaries, oceans, freshwater marshes, salt water marshes, lakes, ponds and riparian vegetation.
- d. Preserve and enhance overall diversity of life and carrying capacities in terrestrial associations, such as forests and grasslands, and their associated wildlife, with special emphasis upon rare and endangered animals and plants.
- e. Minimize disturbance of the region's natural processes and life cycles.
- f. Protect and enhance the distinctive character, identity, and community values of affected areas.
- g. Maintain air quality at levels necessary to protect public health.
- h. Maintain air quality at levels necessary to prevent damage to plant life, animal life and aesthetics.
- i. Prevent degradation of air quality where it is presently of a higher quality than required by Federal-State standards.
- j. Reduce to acceptance levels those noises which have a deleterious effect on the life cycles of wildlife and humans or have a negative effect on aesthetics of the environment.
- k. Protect and enhance public health through the reduction of disease transmission and nuisance factors (water pollutants, disease vectors, toxic elements, plant and animal pests and noise).
- 1. Protect valuable natural and manmade amenities, and increase aesthetic beauty of water bodies, land areas, and the landwater interface.
- m. Promote creation of visually and aesthetically pleasing facilities as an integrated physical element within constituent areas.
- n. Enhance opportunities and increase range of aquatic and errestrial recreation activities for enjoyment of both local and visitor populations.
- o. Provide increased capability and convenience of access to recreation and amenity facilities.

- p. Protect and enhance contemporary cultural values, historical sites and archaeological sites.
- q. Promote an optimum utilization of land, water, energy, air, chemical and human resources, with specific emphasis upon both short-term use and long-term productivity.
- r. Maximize reclamation and reuse of municipal, industrial and agricultural wastewaters and residual solids.
- s. Help maintain, or help the orderly transition of the agricultural environment, where deemed appropriate.
- t. Minimize hardships and disruptions, insofar as possible, to affected residents, business, agriculture, services, access linkages and community cohesion, caused by relocation, displacement, dispersion, or barriers.
- u. Prevent and deter, to the extent possible, disruption to the local economy, jobs, stability, life style and development pattern of affected areas.
- v. Enhance and preserve insofar as possible, employment opportunities in terms of job availability, diversity, stability and mobility.
- w. Enhance opportunities for human betterment through greater and more equitable distribution of wages, goods and public and private services.
- x. Through well-balanced local participation and involvement programs and efforts, help create a legitimate sense of participation, identity, responsibility and cooperation among citizens, organizations, leaders and governments.

NEEDS AND PROBLEMS

INTRODUCTION

46. This section deals with the present and projected demands for water and the sources of water supply to meet these demands through the year 2020. The section also discusses surface and groundwater quality conditions, highlights anticipated water quality problems and presents water quality guidelines used by the Corps in the development of wastewater management alternatives.

WATER REQUIREMENTS

Agriculture

47. Agricultural water requirements are based on projected irrigation needs for each county. Projections assume that water use per irrigated acre will not change over time from that information shown in the latest census of agriculture for each county. Future irrigated acreage requirements for each county have been developed by the various counties and the District offices of the California State Department of Water Resources. Agricultural water requirements for 1970, 1975, 2000 and 2020 are presented in Table 8.

Municipal and Industrial

- 48. Industrial water requirements are derived from data generated in a study by Lawrence Berkeley Laboratory made for the U.S. Corps of Engineers. Industrial water requirements are projected to year 2020. Cooling water is included in the industrial water projections. Most industrial cooling water used in the study area is brackish water. Since the county water supplies projected by the Department of Water Resources are for fresh water supplies, it was necessary to remove cooling water figures in order to make the county industrial water use data comparable to Department of Water Resources projections of water supply. Industrial water requirements were adjusted for Alameda, Contra Costa, San Francisco, San Mateo and Santa Clara Counties.
- 49. Municipal water requirements are based on per capita use data from the Department of Water Resources. An increase in per capita use was projected: a five percent increase between 1970 and 1975, a 10 percent increase between 1970 and 2000 and 10 percent between 1970 and 2020. Per capita use data include industrial water uses, therefore, the industrial water requirements were removed to determine projected municipal water use before municipal and industrial water requirements were projected. County projections are presented in Table 9.

Recreation

50. Outdoor recreation is inseparably tied to the land and its waters. The California Outdoor Recreation Plan (1960) indicates

TABLE 8

AGRICULTURAL WATER REQUIREMENTS

(1,000 of Acre-Feet)

	1970	1975	2000	2020
Alameda	36.6	28.9	17.4	17.1
Contra Costa	124.4	124.4	148.5	150.7
Marin	2.6	2.6	1.6	.8
Napa	16.4	19.0	50.8	58.8
San Francisco	-		-	-
San Mateo	13.8	14.5	15.7	11.9
Santa Clara	133.0	120.5	70.7	43.7
Solano	382.5	400.9	440.0	437.0
Sonoma	49.6	52.6	70.9	86.3
Sacramento	461.8	474.4	500.0	514.0
San Joaquin	1,402	1,436	1,508	1,503
Yolo	832	848	920	956
TOTAL	3,455	3,522	3,744	3,779

TABLE 9
MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS

(1,000 of Acre-Feet)

	1970	1975	2000	2020
Alameda				
Municipal	194.0	214.5	298.3	358.0
Industrial	12.8	12.7	15.8	23.2
Contra Costa				
Municipal	96.3	110.5	189.8	246.7
Industrial	72.6	132.9	140.8	190.4
Marin				
Municipal	38.5	44.9	81.8	112.5
Industrial	1.5	1.6	4.3	11.3
Napa				
Municipal	9.8	11.7	27.3	40.9
Industrial	7.9	19.4	30.8	54.5
San Francisco				
Municipal	136.4	140.1	160.6	174.9
Industrial	2.2	2.3	2.9	4.3
San Mateo				
Municipal	87.7	96.0	121.4	138.8
Industrial	6.6	7.3	12.2	18.6
Santa Clara				
Municipal	198.1	238.3	429.7	593.3
Industrial	8.9	9.9	13.9	19.3
Solano				
Municipal	24.6	28.9	63.7	127.3
Industrial	9.2	9.6	9.8	13.0
Sonoma				
Municipal	32.6	40.1	87.5	122.4
Industrial	5.7	6.4	9.3	13,1
Sacramento				
Municipal	187.5	208.9	326.7	392.0
Industrial	17.5	18.8	23.9	38.0
San Joaquin				
Municipal	53.9	60.5	102.2	122.7
Industrial	23.1	24.5	27.6	42.5
Yolo				
Municipal	13.5	16.9	32.3	48.4
Industrial	11.5	12.1	11.5	14.9

that 60 percent of all outdoor recreation involves water-associated activities. Table 10 gives the present and projected water requirements for fish, wildlife and recreation in each of the counties in the 12-county study area. The requirements shown in Table 10 are for water used in fish and wildlife management areas and refuges.

Fish and Wildlife

- 51. The water requirements for fish and wildlife areas make up the greatest percentage of the demands indicated in Table 10. The consumptive use of water by recreationists at outdoor camping and picnic facilities is minute. However, the domestic water needs of the hundreds of thousands of annual visitors to the Bay Area is substantial and has been included as part of the municipal water requirement.
- 52. In addition to the water demands shown in Table 10 for fish and wildlife management areas, various governmental, public and private water and utility agencies have entered into agreements with the California Department of Fish and Game to insure adequate streamflows and reservoir water levels to protect and improve fishery, wildlife and recreational values. The annual water requirements for streamflow maintenance agreements range from 3,000 acre-feet per year to about 240,000 acre-feet per year. This latter agreement relates to releases from Folsom Reservoir in Sacramento County for fishery management.
- 53. Fish and wildlife resources in the San Francisco Bay-Delta Region are suffering from the results of urbanization and industrialization. Land reclamation, water development projects and water pollution have impaired ecological associations causing loss and deterioration of fish and wildlife habitat. Degradation of the natural environment, including its dependent fish and wildlife resources, has aroused deep and sincere public concern. Local, regional, State and Federal agencies have responded by implementing new standards for environmental protection, including those for wastewater discharge. Many programs and proposed standards outlining improvements in wastewater treatment have been promoted and in some cases implemented. Coupled with the demand for higher quality wastewater discharges there is a growing concern for the conversion, reclamation and reuse of all natural resources. Increasing demands by growing communities for higher quality urban water supplies will continue to deplete existing surface and subsurface water sources which now supply fish and wildlife, aesthetic, and other needs. Unless treated wastewaters are eventually returned to the hydrologic system, extensive local and regional areas will be adversely affected by increasing and conflicting water demands and water shortages.

AVAILABLE WATER SUPPLY

54. In general, most counties have or will have water projects under construction to satisfy water needs for the next 20 years. Table 11 presents information on "dependable" water supplies to

TABLE 10

FISH, WILDLIFE AND RECREATION WATER REQUIREMENTS $\frac{1}{2}$ (1,000 Acre-Feet per year)

	1970	1975	1990-199	5 2000	2020
Alameda	0	0	0	0	0
Contra Costa	37.0	37.0	37.0	38.0	38.0
Marin	1.0	1.0	2.0	2.0	2.0
Napa	0	0	0	0	0
San Francisco	0	0	0	0	0
San Mateo	1.1	1.3	1.0	2.0	3.0
Santa Clara	0	0	0	0	0
Solano	46.3	48.6	56.0	61.8	65.0
conoma	1.0	1.0	1.0	1.3	2.0
Sacramento	65.7	66.7	70.0	70.3	71.0
San Joaquin	67.1	69.0	75.0	75.7	76.0
Yolo	2.0	2.0	2.0	2.0	2.0
TOTAL	221.2	226.6	244.0	253.1	259.0

Source: Documentation of Bulletin 160-70, California Department of Water Resources, August 27, 1971.

^{1/} Requirements are for limited outdoor camping and picnicking only. Most consumptive use for recreation is included with municipal requirements.

TABLE 11

DEPENDABLE WATER SUPPLIES $\frac{1}{2}$

(1,000 Acre-Feet/year)

2020		98.0	230.0	22.0	88.0	3.0	441.0
2000		0.86	228.0	22.0	77.9	3.0	428.9
1990-1995		0.86	227.0	22.0	61.0	3.0	411.0
1975		98.0	134.7	1	27.5	3.0	263.2
1970		98.0	113.2	1	21.1	3.0	235.3
	ALAMEDA	Water Supplies Local Surface and Ground Water	Imports, Local Agencies	Federal Projects	State Water Project	Wastewater Reclamation	Total Water Supplies

CONTRA COSTA

Water Supplies					
Local Surface and Ground Water	154.6	159.0	173.0	125.7	212.0
Imports, Local Agencies	7.06	100.4	137.0	149.8	179.0
Federal Projects	87.9	107.3	195.0	230.7	323.0
State Water Project	1	1	1	1	1
Wastewater Reclamation	1	16.8	18.8	18.8	18.8
Total Water Supplies	332.9	383.5	523.8	525.0	732.8

MARIN

Water Supplies					
Local Surface and Ground Water	33.0	33.0	33.0	33.0	33.0
Imports, Local Agencies	1	1	1	1	1
Federal Projects	10.0	10.0	57.0*	57.0*	57.0
State Water Project	1	1	1	1	ι
Wastewater Reclamation	1	1	ı	1	1
Total Water Supplies	43.0	43.0	0.06	0.06	0.06

Conveyance facilities from Warm Springs Reservoir to southern Marin County were not approved in a recent bond election.

TABLE 11 (Cont'd)

0

DEPENDABLE WATER SUPPLIES $\underline{1}/$ (1,000 Acre-feet/year)

	1970	1975	1990-1995	2000	2020
NAPA					
Water Supplies Local Surface and Ground Water Imports, Local Agencies Federal Projects State Water Project Wastewater Reclamation Total Water Supplies	25.0	25.0	25.0 25.0 25.0 57.0	25.0 25.0 25.0 57.0	25.0
SAN FRANCISCO					
Water Supplies Local Surface and Ground Water Imports, Local Agencies Federal Projects State Water Project Wastewater Reclamation Total Water Supplies	3.0 134.6 - 1.0 138.6	3.0 138.4 - - 1.0 142.4	3.0 159.5 - 1.0 163.5	3.0 159.5 - 1.0 163.5	3.0 175.2 - 1.0 179.2
SAN MATEO					
Water Supplies Local Surface and Ground Water Imports, Local Agencies Federal Projects State Water Project Wastewater Reclamation Total Water Supplies	34.0 71.0 105.0	34.0 80.1	34.0 115.0 - 1.0 150.0	34.0 121.3 - - 1.0 156.3	34.0 135.0 - - 1.0 170.0

TABLE 11 (Cont'd) DEPENDABLE WATER SUPPLIES $\frac{1}{2}$

(1,000 Acre-Feet/year)

2020	185.0 132.0 167.0 100.0 3.0 587.0	191.0 22.0 179.0 42.0	47.0
2000	185.0 92.2 79.6 100.0 3.0 459.8	191.0 22.0 179.0 42.0	47.0
1990–1995	185.0 77.0 55.0 100.0 3.0 420.0	191.0 22.0 179.0 - 434.0	47.0
1975	185.0 33.0 - 54.1	188.4 22.0 178.3 - - 388.7	42.0
1970	185.0 24.9 - 44.1 -	187.5 22.0 178.1 - 387.6	47.0
SANTA CLARA	Water Supplies Local Surface and Ground Water Imports, Local Agencies Federal Projects State Water Project Wastewater Reclamation Total Water Supplies	Water Supplies Local Surface and Ground Water Local Surface and Ground Water Imports, Local Agencies Federal Projects State Water Project Wastewater Reclamation Total Water Supplies	Water Supplies Local Surface and Ground Water Imports, Local Agencies Federal Projects State Water Project Wastewater Reclamation Total Water Supplies

TABLE 11 (Cont'd) DEPENDABLE WATER SUPPLIES $\frac{1}{2}$

2020

2000

1990-1995

feet/year)	1975		1,085.6 1,060.3	1	4 111.1	1	1111	1,1/1.4
(1,000 Acre-Feet/year)	1970		1,085.6	1	85.4		- -	1,1/1.0
		SAN JOAQUIN	Water Supplies Local Surface and Ground Water	Imports, Local Agencies	Federal Projects	State Water Project	Wastewater Reclamation	lotal water supplies

706.0 735.7	1	253.0 250.3		959.0 986.0
656.1	•	51.4		707.5
640.3	•	30.3	•	9.079
Water Supplies Local Surface and Ground Water	Imports, Local Agencies	Federal Projects	State Water Project	Wastewater Reclamation Total Water Supplies

919.0 345.0 -1,264.0 799.0 245.0

988.0 964.4 244.0 273.9 -1,232.0 1,238.3

Water Supplies					
Local Surface and Ground Water	729.1	729.1	789.1	8.161	797
Imports, Local Agencies		1	ı	1	1
Federal Projects	•	1	1	1	ı
State Water Project		ı	ı		1
Wastewater Reclamation Total Water Supplies	729.1	729.1 729.1	789.1	789.1 797.8	797

Source: Memorandum and Documentation of DWR Bulletin 160-170; DWR Bulletin 184, Ten Counties Investigation. 1/

SACRAMENTO

the year 2020 by county. Dependable supplies are defined as firm commitments by water suppliers for their planning purposes. However, based only on these dependable supplies there still may be future shortages and certain counties may have to look to the use of reclaimed wastewaters as an adjunct to multiple purpose reservoir projects presently in the planning phase. Dependable water supplies and potential sources of additional water in the study area to the year 2020 are discussed in the following sections. Assumptions regarding the dependable water supplies are shown on Table 12.

Dependable Water Supplies

- 55. The Federal Central Valley Project will provide water to some of the counties in the study area. It is anticipated that 55,000 acrefeet per year in 1990 and 167,000 acrefeet per year in 2020 will be available from the San Felipe Division of this project for Santa Clara County. Contra Costa County will have 268,000 acrefeet by 2020 from the Central Valley Projects' Contra Costa Canal and Folsom North Canal. The Folsom South Canal Unit will provide Alameda County with 22,000 acrefeet by 1990. Water supplies for San Joaquin County are projected to increase from 53,000 acrefeet per year from Delta Mendota Canal to 317,000 acrefeet in 2020 as a result of additional supplies made available by the Folsom South Canal. Sacramento County will have 140,000 acrefeet by 2020 from the Auburn and Folsom Reservoirs of the Central Valley Project.
- 56. In San Joaquin County, the water use from the Corps of Engineers' New Hogan Reservoir is projected to increase from 20,000 acre-feet per year to 42,000 acre-feet by 1990 and then decline to 28,000 acre-feet by 2020. Warm Springs Reservoir is under construction by the Corps of Engineers and will supply Sonoma County 67,000 acre-feet by 1990. Sonoma County also will obtain 42,000 acre-feet per year from Lake Mendocino Reservoir. Marin County could be supplied with 47,000 acre-feet by 1990 from Warm Springs Reservoir.
- 57. The Bureau of Reclamation's project for Solano County will supply 179,000 acre-feet per year by 2020.
- 58. The California State Water Project is currently nearing completion by the Department of Water Resources. The North Bay Aqueduct of the State Water Project will provide Solano County with 42,000 acre-feet per year and Napa County will receive 25,000 acre-feet per year. Water via the South Bay Aqueduct of the Project will provide Santa Clara County with 100,000 acre-feet by 2020 and Alameda County with 88,000 acre-feet by 2020.

TABLE 12

ASSUMPTIONS REGARDING DEPENDABLE WATER SUPPLIES SAN FRANCISCO BAY & DELTA REGION 1

the availability of water supplies for the San Francisco Bay and Delta Region is based upon the following assumptions in source data regarding existing and proposed projects and arrangements:

- (a) ALAMEDA. Imports East Bay MUD, 102 AF in 1967 to 230 AF in 2020. Central Talley Project Folsom South Canal, 22 Ai State Water Project South Bay Aqueduct, 18 AF in 1967 to 88 AF in 2020.
- (b) CONTRA COSTA. Imports East Bay MUD, 85 AF in 1967 to 179 AF in 2020. Central Valley Project Contra Costa Canal and Folsom South Canal, From 54 AF in 1967 to 268 AF in 2020. Wastewater reclamation reflects agreement between Contra Cost County Water District and Central Contra Costa County Sanitary District,
- (c) MARIN. Federal Projects Sonoma/Marin Aqueduct 2 fed by Mars Springs Reserved r3/ and Lake Mendocino, 10 AF in 1967 to 57 AF in 1990.
- NAPA. State Water Project North Bay Aqueduct, 25 AF by 1990. (P)
- (e) SACRAMENTO. Central Valley Project Increase in water supply largely from Auburn and Folsom South Units, 22 AF in 1967 building up to 253 AF by 1990 then declining to 245 AF by 2020.
- Increase in Hetch Hetchy Aqueduc supply, 180 AF in 1967 to 448 AF in 2020. Surplus will be sold. SAN FRANCISCO.
- Other Federal (g) SAN JOAQUIN.4/ Central Valley Project - Delta Mendota Canal and Folsom South Canal, 53 AF in 1967 to 317 AF in 2020. Projects - Increase in water supply from New Hogan Reservoir, 20 AF in 1967 to 42 AF in 1990, then declines to 28 AF by 2020.
- SAN MATEG. Imports Purchase of surplus Hetch Hetchy Aqueduct water from SFWD, 66 AF in 1967 to 135 AF in 2020. (H)
- (i) SANTA CLARA. Imports Purchase of surplus Hetch Hetchy Aqueduct water from SFWD. Central Valley Project San Felipe Division, 55 AF in 1990 to 167 AF in 2020. State Water Project South Bay Aqueduct, 39 AF in 1967 to 100 AF in 2020.
- SOLANO. State Water Project North Bay Aqueduct, 42 AF by 1990.
- Federal Projects Warm Springs Peservoir will supply 67 AF by 1990. SONOMA. (k)
- Indian Valley Reservoir will supply 60 AF by 1990.
- 1000 acre-feet.
- Marin County would have to approve a bond issue for construction of the aqueduct. 西宮町
 - Assumed to be on line in 1990.
- 285,000 A.F. in New Melones Reservoir expected to be available to the Central Valley Project by 1980 has not been included because much of the water may be used in other counties outside the 12-county S.F. Bay-Delta Region.

- 59. Following is a brief discussion of local sources of water for the study area. The principal source of water supply for Alameda County is the East Bay Municipal Utility District's Mokelumne River imports which will be 230,000 acre-feet by 2020. For Contra Costa County, East Bay Municipal Utility District's imports from the Mokelumne River will be 179,000 acre-feet by 2020. San Joaquin County receives its local surface water supplies largely from Delta Channels, and also from the Mokelumne and Calaveras Rivers.
- 60. In San Francisco, the principal source of water supply is the San Francisco Water Department's Hetch-Hetchy Aqueduct imports from the Tuolumne River, Alameda Creek, and San Mateo County Reservoirs. Santa Clara County plans to purchase 132,000 acre-feet by 2020 from the San Francisco Water Department supply. The principal source of water supply for San Mateo County is also the San Francisco Water Department's Hetch Hetchy Aqueduct which is projected to increase to 135,000 acre-feet by 2020.
- 61. Local surplus water supplies diverted from the Sacramento and American Rivers under water-rights agreements with the Bureau of Reclamation will supply Sacramento County with upwards of 380,000 acre-feet by 2020. The city of Vallejo in Solano County also imports 22,000 acre-feet from the Sacramento River Basin.
- 62. Yolo County receives part of its water supply from Clear Lake and Cache Creek, 102,000 acre-feet per year. From the Sacramento River, Yolo County will receive an additional 402,000 acre-feet by 2020. The Tehama-Colusa Canal, now under construction, will deliver to the Dunnigan Water District 19,000 acre-feet per year. The Indian Valley Reservoir, recently authorized for construction by the Yolo County Flood Control and Water Conservation District will supply 60,000 acre-feet per year.

Potential Sources

- 63. In the event of shortages in Contra Costa County the logical sources of supply would be the proposed Kellogg Division of the Central Valley Project for the eastern part of the county and a transfer of water from Alameda County via East Bay Municipal Utility District facilities for the western part of the county.
- 64. Marin County may be short 36,000 acre-feet by 2020. The proposed Sonoma-Marin Conduit could convey water diverted from the Russian River to eastern Marin County.
- 65. The proposed Knights Valley Aqueduct could convey water diverted from the authorized (but inactive) Knights Valley Reservoir in Lower Russian River basin to existing Lake Hennessey in Napa. Napa Valley would be able to get 25,000 acre-feet per year. The proposed Spring

Valley Pump Storage Project to develop water from the Napa River is an alternate way to meet water shortages in Napa County. In San Joaquin the most likely additional source to meet water shortages would be the New Melones Reservoir.

- 66. Pote: I sources to meet anticipated shortages in San Mateo County are possible State Water Project imports, Bean Hollow Reservoir and wastewater reclamation. Wastewater reclamation is also being considered by Santa Clara County to meet its projected shortages. It already plans on using 3,000 acre-feet of reclaimed wastewater by 1990. This amount can be increased considerably by the use of reclaimed sewage to irrigate parks and recreation facilities, industrial process water, and groundwater recharge.
- 67. A likely source of supply to meet shortages in Solano County would be increased imports of water from the Sacramento Basin. Also shortages could be met by the proposed West Sacramento Canal Unit of the Central Valley Project. The most likely sources to meet demands in Sonoma County are enlargement of Lake Mendocino and additional imports from South Fork Eel River subsequent to the completion of Warm Springs Reservoir. Shortages in Yolo County may be met by enlargement of the proposed West Sacramento Canal Division of the Central Valley Project.

ASSOCIATED PROBLEMS

Surface Water Quality Degradation

- 68. The water quality of the Bay-Delta Estuary, as defined in traditional pollution terms, has improved on the whole over 1950 conditions. Biochemical oxygen demand, the amount of oxygen required for bacterial decomposition of organic wastes over a specified period of time, generally has decreased. Dissolved oxygen concentrations have increased to the point where most aquatic organisms have sufficient amounts to survive in most parts of the Bay-Delta Estuary. Coliform counts have been reduced significantly by chlorination of waste effluents. However, dissolved oxygen depletions still occur in the South Bay, south of Dumbarton Bridge, and in the San Joaquin River downstream of Stockton. Recent studies indicate that the biochemical oxygen demand assimilative capacity of the Sacramento River below the city of Sacramento is rapidly being approached. Studies from the State San Francisco Bay-Delta Water Quality Control Program reveal that biostimulatory materials (mostly nitrogen and phophorus which are necessary for algae growth) and toxicity may be more applicable indicators of pollution and eutrophication than biochemical oxygen demand and dissolved oxygen concentrations.
- 69 Studies indicate that the discharge of municipal and industrial wastewaters have a toxic effect on benthic organisms, causing a decrease in species diversity which is a common criterion for measuring

the degree of pollution of a body of water. More significantly, these benthic organisms are important as a vital link in the food chain of higher aquatic organisms such as fish. Toxicity has also been documented as a cause of several recent fish kills in the Bay-Delta Estuary. Moreover, the effects of toxicity in non-lethal concentrations, while not killing fish outright, impair fish so that they die from other causes or cannot continue normal activities such as feeding, migration and reproduction.

- 70. State Bay-Delta Program studies also indicate that municipal and industrial waste discharges contribute significantly to the reservoir of biostimulatory nutrients in the Bay-Delta Estuary. These discharges have been cited as a possible cause for annual summer algal blooms in the Delta and lower reaches of the Sacramento and San Joaquin Rivers. Discharge of agricultural drainage water from the San Joaquin Valley into the estuary via agricultural drains, programmed to be completed in the late 1970's and 1980's, would also contribute to increased levels of nutrients in the estuary. Studies also indicate that algal growth in the Bay is not now limited by nutrient levels but by some unknown factors, possibly turbidity. Algal blooms have the following effects on water quality: Impair the aesthetics of the water and are an indicator of eutrophication or aging of the estuary: reduce the beneficial uses of water; and while producing excess oxygen during the day, algae can depress oxygen levels during the night to anaerobic conditions, thereby seriously impairing the aquatic environment's ability to sustain itself.
- 71. It has been estimated that 10,000 to 20,000 pounds of pesticides in the form of non-degradable chlorinated hydrocarbons entered surface waters of the Bay-Delta system in 1965. Concentrations in parts of the estuary exceed the maximum concentration (50 parts per trillion) recommended by the National Technical Advisory Committee on Water Quality Criteria. While this concentration seems very low, it must be noted that concentrations have been found in tissues of aquatic life up to 20,000 times that of their environment and in excess of the considered safe level for human consumption.

Groundwater Problems

72. The extensive groundwater basins of California provide natural regulation for runoff from tributary drainage areas and for precipitation directly on overlying lands. About one-half of the water presently used on irrigated lands and for domestic, municipal and industrial purposes in the State is regulated in groundwater basins. Additional natural regulation could be provided if the presently unused groundwater storage capacity were utilized to the full extent of the possible safe yield of the underground basins. Furthermore, as additional surplus water supplies are developed and made available for storage in groundwater basins, the safe yield of the underground reservoirs can be increased.

- 73. The estimated mean seasonal requirements for water in California, in 1967, were approximately 28,600,000 acre-feet, of which about 11,500,000 acre-feet were supplied from underground sources. In 1967 about 580,000 acre-feet were withdrawn from the San Joaquin Valley and one million acre-feet from the Sacramento Valley.
- 74. The draft on groundwater in the San Francisco Bay Area amounts to about 300,000 acre-feet seasonally. The net extraction of groundwater in the area surrounding San Francisco Bay exceeds the safe yield of the underground basins by a large amount. Sea-water intrusion exists, or is threatening, in many of the coastal basins. Facilities for artificial recharge of underground storage are presently being operated in Santa Clara and Alameda Counties.
- 75. A large part of the domestic, industrial, and irrigation development of the Central Coastal Area is dependent upon development of groundwater storage, due to the generally small runoff available in the streams of the area. Draft on several of the major groundwater basins of the area has been so great that serious problems have arisen with respect to their adequacy, not only for future development, but also for maintaining the existing economy. Water levels in many of the coastal basins have fallen below sea level and progressive lowering is occurring in the San Ynez, Santa Maria, San Benito, and South Santa Clara Valley Basins. The 1967 gross pumpage in the Central Coastal Area approximated 750,000 acre-feet, of which about 60 percent occurs in the Salinas Valley.
- 76. Utilization of groundwater for irrigation in the Central Valley did not become significant until after 1900. However, the more or less complete diversion of available surface water supplies during the irrigation season in the south San Joaquin Valley prior to 1910, gave impetus to the development of supplemental supplies from groundwater storage. The 1967 pumpage of groundwater in the Sacramento Valley has been estimated to be about 1.0 million acre-feet, and in the San Joaquin Valley to be about 580,000 acre-feet per season. Quality problems have been evidenced in some valley basins. High groundwater tables existing over large areas of the Sacramento Valley present a problem of drainage for the improvement of agriculture.

Other Water Quality Problems

77. Naval and merchant ships still discharge raw sewage into Bay-Delta waters. This poses a pollution problem in the receiving waters in the vicinity of Alameda Naval Air Station when aircraft carriers are in port. Discharge of raw sewage from house boats causes limited pollution, particularly in Richardson Bay. Wastewater from the three largest dischargers to the estuary, the cities of Sacramento and San Francisco (North Point and Southeast Treatment Plants) and the East Bay Municipal Utility District (serving the cities of Oakland, Berkeley, Emeryville, etc.) presently receives only primary treatment with chlorination. As previously mentioned,

the cities of Sacramento and San Francisco have combined sanitary and storm sewage systems which necessitate discharge of raw wastewater to the receiving waters during rainy periods. The Navy and involved local agencies are making considerable progress in solving these problems. The Navy is providing its ships with storage tanks and is constructing shoreside waste disposal facilities. East Bay Municipal Utility District is upgrading its treatment facilities and the cities of San Francisco and Sacramento are evaluating various solutions to their combined sewage problem.

REGIONAL WATER QUALITY GOALS AND GUIDELINES

- 78. The State of California has established water quality objectives based on beneficial uses of water and has initiated the planning, implementation and enforcement actions necessary to maintain these objectives. To satisfy the requirements of the State's Porter—Cologne Act, as well as Federal planning requirements, the State developed in 1971 interim basin plans to serve as water quality planning and enforcement guidelines pending the adoption of comprehensive water quality control plans which currently are under preparation. The water quality objectives and waste discharge prohibitions from those State interim basin plans which interface with the San Francisco Bay Delta Region are presented in Attachment B to Appendix A.
- 79. The Corps' wastewater management study was directed toward the needs anticipated in the year 1975-2000 timeframe. Since the State's comprehensive water quality control plans were still to be completed, planning criteria for this period regarding water quality objectives, waste discharge prohibitions and allowable discharge levels of critical pollutants were not available. The magnitude of the wastewater treatment and residual solids disposal problems, the public's increasing demand for high water quality standards consistent with environmental objectives, and the growing concern of all levels of government for improved wastewater management lead to the conclusion that planning criteria will be much more stringent as time progresses. Such a trend was evidenced in late 1972 when the water quality objectives and waste discharge prohibitions for the San Francisco Bay Basin were amended as tentative preliminary input to the comprehensive water quality control plans. This more stringent thinking is presented in Attachment C to Appendix A. These water quality objectives and waste discharge prohibitions establish a lower bound of water quality goals and guidelines for the Corps' planning efforts in wastewater management.
- 80. Realizing that future water quality objectives and water discharge prohibitions could not be predicted at this time, the Corps' effort was directed rather toward defining broad treatment technologies which could be expected to be compatible with future stringent wastewater mangement discharge conditions. Three such broad technological

approaches are available; physical-chemical treatment systems, advanced biological treatment systems and land treatment systems. None of these systems is new in concept and the unit processes involved currently are in use. It was felt that the unit processes from these systems could be combined to achieve comparable high levels of wastewater treatment and used, to the scale needed, in wastewater management alternatives for the San Francisco Bay and Delta Region. These and other treatment methodologies are discussed in the next major section of this report.

- 81. The State of California furnished the Corps with several items of general and specific guidance regarding water quality objectives and waste discharge prohibitions, non-degradation and land application systems. The following items of guidance from the State were used by the Corps in the development of wastewater management alternatives.
- a. Statewide standards for the safe direct use of reclaimed wastewater for irrigation and recreational impoundments of the California State Department of Public Health from Title 17, California Administrative Code, Sections 8025 through 8050.
- b. Resolution No. 68-16 of the California State Water Resources Control Board commonly called the Board's "non-degradation" policy. The key provision of this resolution is as follows:

"Whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water and will not result in water quality less than that prescribed in the policies."

- c. Letter dated 26 December 1972 from the State of California indicating that:
- (1) "There should be no surface runoff from the land application sites of either wastewater or storm water at any time when wastewater is present on the site."
- (2) "No controllable water quality factor shall degrade the quality of any groundwater. Exceptions will be considered where the controllable factor is reclaimed wastewater and where existing and potential beneficial uses will be protected."

WASTEWATER TREATMENT METHODS

INTRODUCTION

- 82. A wide variety of processes can be used to treat wastewater prior to final disposal. The choice of the method of treatment is determined by wastewater management goals and objectives. As these goals and objectives become more stringent, based on State and Federal requirements, the degree of wastewater treatment must be increased.
- 83. As stated previously, water quality objectives and waste discharge prohibitions for the year 1975-2000 timeframe could not be predicted. Consequently, it was concluded that the formulation of wastewater mangement improvements would be based on high removal waste treatment technologies.
- 84. Two general waste treatment methodologies have been addressed in this study for the development of wastewater management improvements. One treatment method combines various conventional treatment units together forming an advanced treatment process and discharges treated effluent to receiving surface water bodies. The second method involves the application of treated wastewater on designated land areas.

CONVENTIONAL TREATMENT

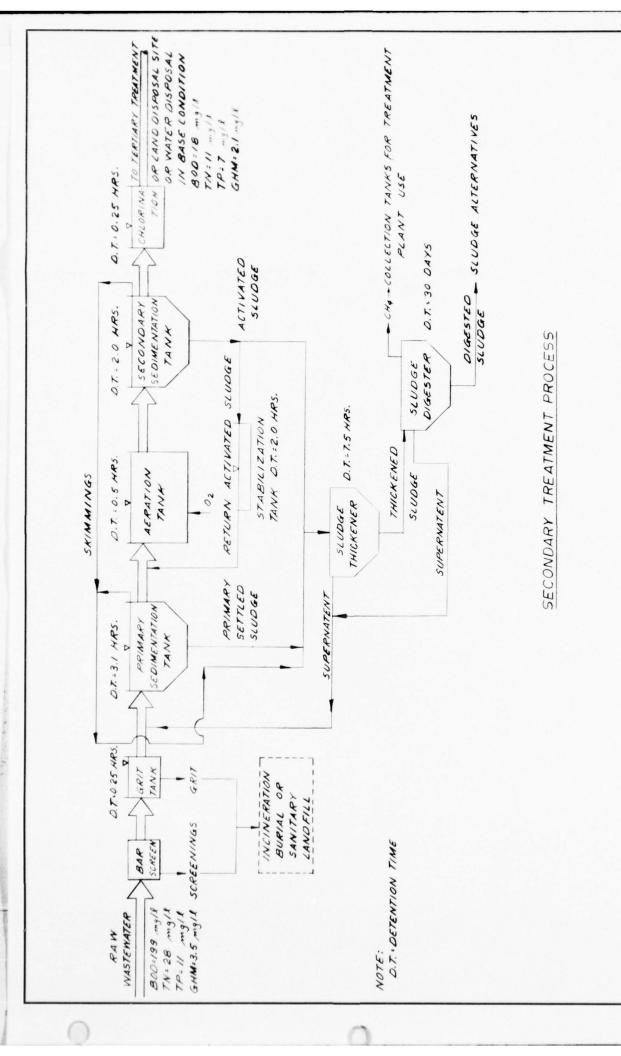
- 85. In order to provide for the maximum possible reduction of pollutants in facilities discharging to surface waters, maximum consideration was given to developing a full tertiary treatment process. Rationale for such a treatment process was to achieve as close to 99 percent removal as possible of critical pollutants (short of demineralization) and to provide a process comparable to land treatment. Since this process would provide an extremely high level of treatment and might not be fully required to achieve future water quality objectives, a series of advanced treatment processes providing lower degrees of treatment was considered. These advanced treatment processes, however, would provide removals higher than those required to meet current water quality objectives. Conventional treatment processes considered are discussed in the following sections.
- 86. When physical-chemical treatment is used (see Figure 2), the incoming wastewater passes through screening devices to remove the large solid matter and grit. Chemicals, lime or alum, are added to the wastewater in a flash mixing basin which provides for a rapid high intensity mixing of the chemical coagulant with the wastewater. Flocculation, or the development of large particles as a result of the chemica' addition, occurs next and prior to the removal of the suspended solids in the sedimentation tank. The treated wastewater is then disinfected with chlorine and discharged to the receiving surface water body. The sludge collected at the bottom of the sedimentation tank is pumped to a sludge thickener. This sludge is high

SALANDARAGAS

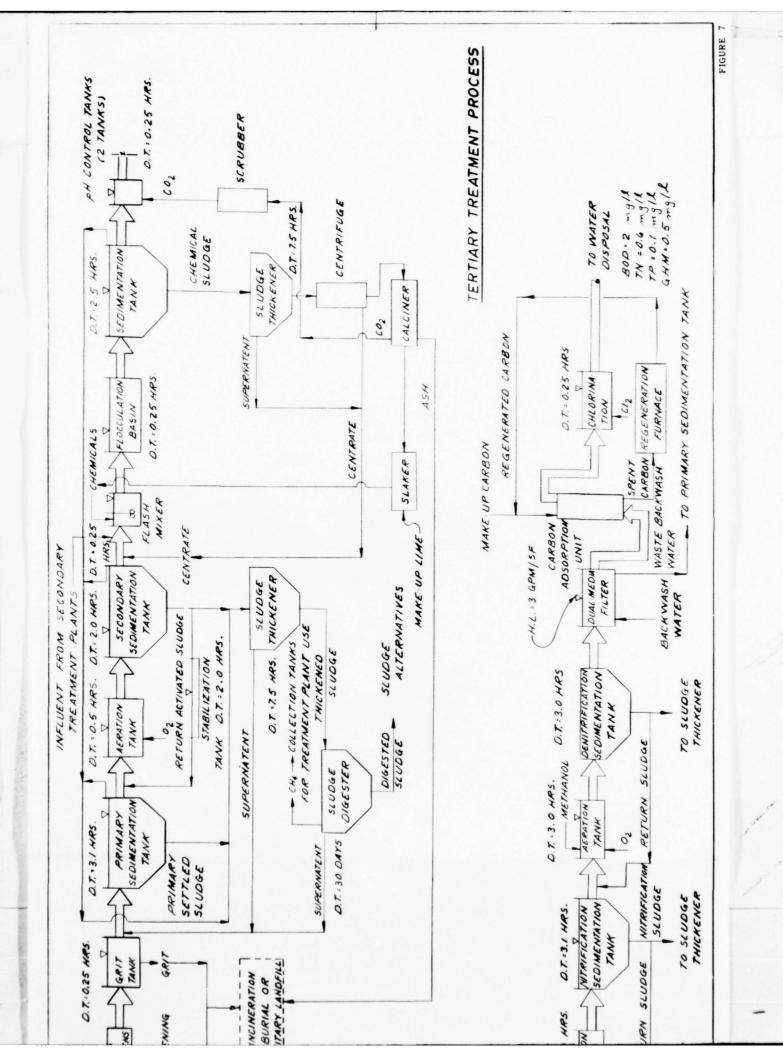
FIGURE

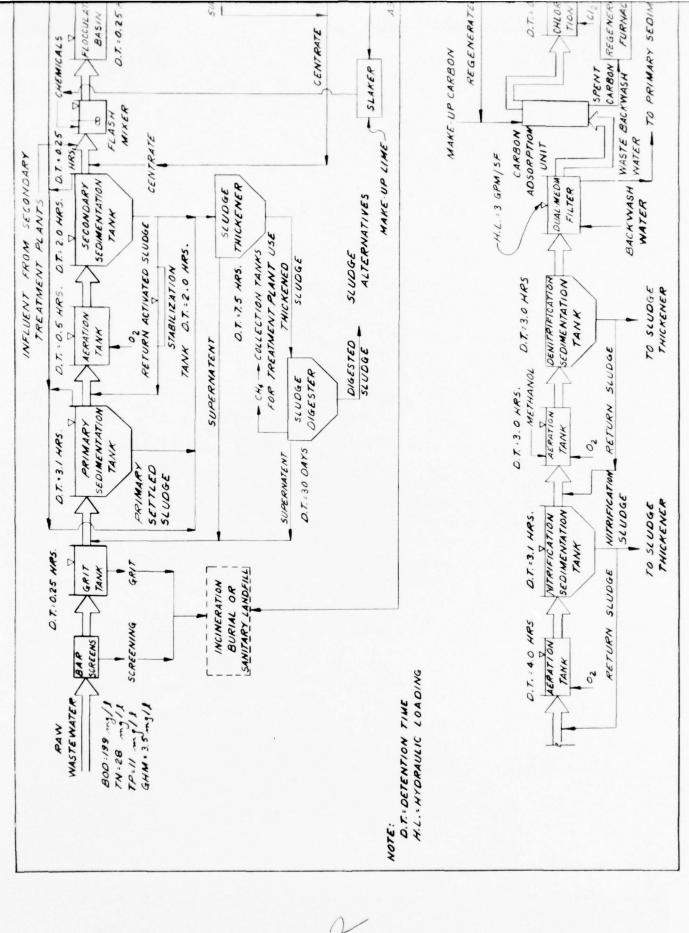
in chemical composition (lime) which can be recovered by recalcination methods for later reuse. This treatment process will result in removal of approximately 70 percent of the available BOD, 50-65 percent of the nutrients (60 to 80 percent removal of phosphorus and 20 to 50 percent removal of nitrogen), and 65 percent of the heavy metals present but there is no removal of total dissolved solids. This type of treatment was not used in the development of wastewater management alternatives because the trend in the San Francisco Bay-Delta Region is toward biological treatment. However, the better aspects of the physical-chemical process, such as lime utilization for phosphorus removal, were used in developing the full tertiary and advanced treatment processes.

- 87. The basic biological treatment process (see Figure 3) consists of screening devices and primary sedimentation for the removal of settleable organics, floating oils, and grease. The wastewater then enters aeration tanks where it is mixed with activated sludge and agitated by compressed air. After aeration and mixing, the wastewater flows to final settling tanks where the sludge is separated by sedimentation. A portion of the settled sludge is returned to the inlet end of the aeration tank to innoculate the incoming sewage. The treated wastewater is chlorinated prior to disposal. This basic biological treatment process can have several variations. Those used in this study include:
- a. Addition of a nitrification/denitrification process (see Figure 4) in which ammonia nitrogen is biologically converted to nitrogen gas;
- b. Addition of dual medial filter (see Figure 5) for the purpose of polishing the treated wastewater. The filter is employed for the removal of finely divided suspended material. These treat—mer processes can be combined with the basic biological treatment process so that partial or full tertiary treatment (see Figures 6 and 7) is applied to wastewater. Tertiary treatment provides for the removal of pollutants not completely removed by secondary treatment process, such as suspended solids, refractory organics, and nutrients.
- 88. A full tertiary treatment as used in this report consists of conventional biological treatment, 98 percent phosphorus removal, nitrification and denitrification, dual media filtration, and carbon adsorption. Sludge is collected from the sedimentation tanks and pumped to an anaerobic digester for stabilization. For those unit processes which use chemicals: i.e., phosphorus removal and carbon adsorption, the chemicals will be recovered by thermal regeneration for later use.



ADVANCED TREATMENT PROCESS TYPE B





89. Treatment processes discussed in this report result in the removal efficiencies shown in Table 13. Removal efficiencies shown were obtained from various published engineering documents, textbooks and professional articles. They represent average values for the individual processes shown.

LAND APPLICATION

Introduction

90. Of the general types of treatment considered in this study, land application or the "living filter" is the most unique. Instead of relying on individual tertiary or advanced treatment units in the treatment sequence as is done for the more conventional physical chemical and advanced biological systems, land application relies on the natural in-place soils and associated ground cover (the living filter) to accomplish tertiary treatment. The process is truly unique among unit treatment processes in that while the applied wastewater is being renovated and impurities removed, it is also being reused as irrigation water for the ground cover. Not only does land application allow an initial reuse of wastewater as irrigation water but it also provides additional quantities of high quality water which have been renovated in the plant-soil system.

Background

- 91. The land-soil system acts as a filter, removing impurities from the wastewater and at the same time supplying the soil-plant system with nutrients and water for growth of plant life. The name "living filter" has been used to describe the process since the ground cover is an integral part of the system. The concept of applying waste products to land areas has been practiced for centuries. Application of treated wastewaters to land areas is a proven concept in many areas. A sewage farm for Melbourne, Australia, has been successfully operating since the previous century. Cattle and sheep, raised for human consumption, have been fed forage grown with wastewaters on the farm.
- 92. About 40 percent of the total sewage produced at inland facilities in England and Wales is applied to agricultural land. In California such large cities as Fresno and Bakersfield practice land application of wastewaters. Nearly all of the communities in the Southern San Joaquin Valley and Tulare Basin practice some form of land application, principally through irrigation of crops and pasture.

TABLE 13

CONVENTIONAL WASTEWATER TREATMENT PROCESSES - AVERAGE REMOVAL EFFICIENCIES

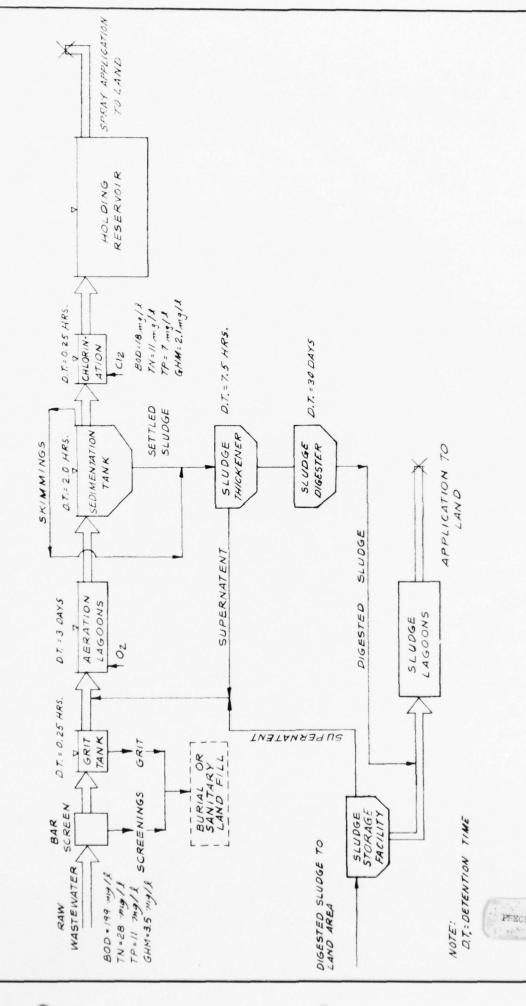
	: AVERAGE REMOVAL EFFICIENCY %				
	:Biochemical	:	:	: Gross	: Total
Treatment	: Oxygen	: Total	: Total	: Heavy	:Dissolved
Process	: Demand	: Nitrogen	: Phosphorus	: Metals	: Solids
Secondary 1/	: : 91 :	: : 60 :	: : 32 :	: : 40	: : <1 :
Aerated Lagoons	: : 85	: : 10	: : 10	: : 25	: <1
Advanced Secondary Type A 2/	: : : 91 :	: : : 68 :	: : : 32 :	: : : 40 :	4
Advanced Secondary Type B <u>3</u> /	: : 96 :	72	: : 86 :	: : : 52 :	: 10
Advanced Secondary Type C <u>4</u> /	: : 96 :	: : 96 :	: : 86 :	: : 79 :	<1
Full Tertiary 5/	: 99	98	: : 99	: : 85	: 10

- 1/ Includes primary sedimentation, aeration, secondary sedimentation, and chlorination.
- 2/ Includes secondary treatment plus nitrification.
- 3/ Includes secondary treatment plus dual media filtration.
- 4/ Includes secondary treatment plus 80% phosphorus removal and nitrification/denitrification.
- 5/ Includes secondary treatment plus 98% phosphorus removal, nitrification/denitrification, dual media filtration, and carbon adsorption.

- 93. In the San Francisco Bay-Delta Region about 5 to 10 percent of all wastewater flows are disposed of by some form of land application. Although golf course irrigation and hillside spraying are the two most common methods, the city of Pleasanton intensely irrigates about 100 acres of pasture lands on which cattle are grazed. In California, as a whole, over 200 municipalities, communities and industries practice some form of land application with treated wastewaters.
- 94. The "living filter" concept has the following unique features which make it an attractive alternative to conventional advanced wastewater treatment when considering total water resource management:
- a. Irrigation with treated wastewaters on crop and pasture lands could replace or release higher quality water supplies normally used for irrig tion.
- b. Nutrients are returned to the land where they are beneficially used by plants.
- c. Discharges to water bodies would be lessened; this will insure that less pollutants, such as BOD, nitrogen, and phosphorus, will be directly entering the surface waterways.
- d. The fate of waste materials can be more easily monitored and controlled on land areas.
- e. It becomes possible to avoid the constant upgrading of treatment plants in order to meet higher standards.
- f. Crops and pasture grasses grown on land application sites provide additional benefits.
- g. Water renovated by the "living filter" can be recollected and reused for additional beneficial purposes.
- 95. Prior to land application, wastewater will be given secondary-level pretreatment followed by chlorination to destroy bacterial pathogens. Pretreatment methods considered in this study include the activated sludge process, Figure 3 (Land Treatment Type X), and treatment in aerated lagoons, Figure 8 (Land Treatment Type Y). Either of these systems will pretr at wastewater to an acceptable and comparable degree amenable to further treatment by the "Living filter."

Application Methods

96. The three most common methods of applying wastewater in land application systems are by spray irrigation, overland runoff (sheet flow) and rapid infiltration. Spray irrigation can be accomplished with in-place or travelling spray rigs. Overland runoff utilizes ditches, usually about 100 feet apart per one percent of slope. General ground slopes are usually in the range of 2-6 percent. Water released from the ditches flows over the soil cover and top soil



LAND TREATMENT PROCESS TYPE Y

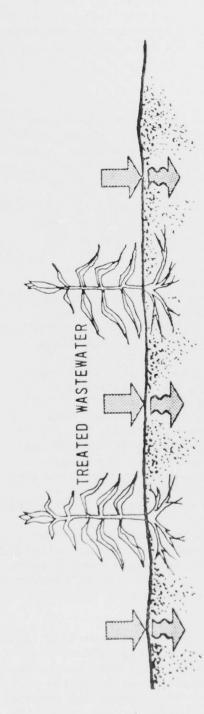
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surface layer. Rapid infiltration applies water on a landsite for 10-14 days with resting periods of a few days between applications. A fourth method, ridge and furrow irrigation, could be used for crops that are sensitive to spray on their foliage. After preliminary evaluation of these methods, spray irrigation was considered to have the widest application to the study area and was the only method evaluated in this report.

Removal Mechanisms

- 97. The land treatment process utilizes the entire bio-system, including the soil and its vegetative cover, to purify the wastewater. Wastewater is renovated by three basic internal mechanisms operating within the soil, namely plant uptake; filtration, ion exchange and fixation; and reactions with soil micro-organisms. These mechanisms are active to some degree in all types of soil and control the effectiveness of the land to sustain wastewater renovation and optimum crop production. The sketch on page 60 illustrates the removal mechanisms. They are discussed in more detail in the following sections.
- Of primary concern are the amounts of the various nutrients removed from the applied wastewater by crop and pasture lands. The amounts of major nutrients such as nitrogen and phosphorus lost through plant uptake represent quantities lost through harvesting all or portions of the growing vegetation. Quantities removed per acre depend not only on the content of the element in the part of the crop that is harvested but on the total weight of dry material removed. Since both plant composition and yield vary widely, different amounts of the nutrients are removed by different plant species. For this study, it was assumed that crops such as cotton, sugar beets or corn (crops which use about 150 pounds of nitrogen per acre per year) would be harvested and that pasture grasses such as ryes, bromes and fescues would be grown. These pasture grasses remove about 200 pounds of nitrogen per acre per year. In general, phosphorus is removed by most crops at rates comparable with about one-fifth of the nitrogen removal rate.
- 99. Physical and chemical phenomena are important among removal mechanisms not only as they relate to the accumulation of pollutants in the upper path of the soil horizon, but also with respect to the indirect role of soil chemistry in relation to biological renovation and to the influence of chemical interactions on soil physical properties.
- a. Filtration is the straining or mechanical removal of suspended particles which are larger than the openings between the soil grains. This, for the most part, takes place near the surface and initially removes the very large particles. As filtration proceeds, the openings become smaller because of accumulating material and smaller particles are removed. The process is essentially the same as that occurring in mechanical treatment plants. However, treatment plant filtration rates are many times the rates contemplated for land application. This allows the organic fraction of

LAND TREATMENT PROCESS



ROOT SYSTEMS

SOIL PARTICLES

- TAKE UP SOLUBLE NUTRIENTS

- MECHANICALLY STRAIN SUSPENDED SOLIDS

- ADSORB BACTERIA, VIRUSES, PHOSPHORUS,

AND HEAVY METALS

SOIL MICROORGANISMS - CONSUME DISSOLVED ORGANIC, NITROGENOUS AND PHOSPHORUS MATERIALS

~)

ZONE OF SATURATED SOIL

DRAIN PIPE OR WELL

the solids to degrade and become part of the soil system. Because of the relatively low application rates and subsequent organic decomposition, the living filter should be able to perform indefinitely, without clogging or chemical buildup problems.

- b. Ion exchange, perhaps the most commonly recognized chemical process which occurs in soils, is related to characteristics of both the clay fraction and organic matter. Although ion exchange is more important where considering dissolved chemicals which are positively charged (cations), soils under certain conditions also have a limited capacity to retain negatively charged chemicals (anions). Cation exchange capacity increases both with the organic content of soils and soil acidity (pH). Heavy metal cations in wastewater applied to soils must compete with common cations in normal exchange phenomena. Since heavy metal cations are normally present in wastewater at much lower levels than common cations, this exchange phenomena, while significant, is not the most effective process in the removal of heavy metals from solution.
- c. Adsorption is the most important process by which pollutants are removed from wastewaters applied to soils and is defined as the capacity of soils to retain certain dissolved chemicals so tightly that they can only be removed from the solid fraction with great difficulty. It differs from ion exchange in that, by definition, exchangeable ions are freely replaceable. Several processes may be involved in adsorption. Initially, it involves an ion exchange phase but eventually the surface adsorbed ions become incorporated within the soil structure as an impurity unavailable to the soil solution. The process is particularly significant in the removal of heavy metals and phosphate and is aided by organic matter present in the soil.
- d. So far the removal mechanisms described have depended upon physical and chemical interactions of constituents in the soil solution with some component of the soil structure. However, if the concentrations of cations and anions in the soil solution become sufficiently high, mutual association between specific types of constituents in solution will occur to form solid chemical compounds with limited solubility. Although the concentration levels at which precipitation will begin to occur depend upon the individual compounds in question, many of the cations and anions found in wastewater can potentially precipitable in the soil.
- 100. Biochemical reactions which occur in the soil are those directly or indirectly related to processes by which micro-organisms degrade the applied wastewater organics. Primary micro-organisms of the soil are bacteria, fungi, algae and soil animals such as protozoa, earthworms and nematodes. These organisms are the ecological units that may likely have the largest effect upon wastewater applied to land. They are important in that they can transform wastewater

components extensively from gases, liquids or solids. Transformation processes involving micro-organisms have significant effects upon carbon, nitrogen, sulfur, and phosphorus and include mineralization and immobilization, nitrification, denitrification, and oxidation-reduction.

- 101. The following summary briefly describes the effects of the foregoing removal mechanisms on certain critical constituents:
- a. Suspended Solids Suspended solids removal by the "living filter" can be quite efficient. Most authorities credit a percolation type system such as rapid infiltration or spray irrigation with essentially complete (99%+) removal. Overland runoff is somewhat less efficient, less predictable and much more difficult to control. Even with these drawbacks, it is estimated that 80 percent of suspended solids could be removed from secondary effluent by overland runoff. The main mechanism involved in spray irrigation and rapid infiltration is filtration by the soil mantle. That of overland runoff is filtration through the organic litter on the soil surface and may include some filtration horizontally in the first few inches of soil.
- b. Oxygen Demanding Compounds These materials are generally considered to be the relatively easily degraded organic compounds. The Biochemical Oxygen Demand (BOD) is accepted as an index of their presence. Organic decomposition in the soil is essentially the same as that occurring in biological secondary treatment processes. The same groups of microorganisms operate in both systems. Biological secondary treatment merely increases the concentration of active microorganisms and provides an ideal environment in order to speed up the decomposition process, which occurs naturally in soil systems.
- c. Dissolved Solids Total dissolved solids, also expressed as TDS, consist mostly of sodium, potassium, magnesium and calcium sulfates and chlorides in solution. Most of these materials are not removed in any significant degree from wastewaters by soils. Although significant ion exchange can occur in the soil matrix, this is only an exchange of ions rather than a net removal of dissolved solids. Neither is there a significant removal of dissolved solids by plant upt. , especially in relation to the total quantities in the applied wastewater. In arid or semi-arid areas where evaporation is significant, there can be a net salt accumulation in soils as a result of irrigation or water spreading operations if provisions for adequate leaching are not provided. Salt buildup in the soil horizon due to the removal of carriage water by evapotranspiration historically has been prevented or corrected by applying excess amounts of irrigation water which percolate the applied or previously built-up salts beyond the plant root zone where they no longer are harmful to plants. In steady state conditions, all dissolved solids applied by the wastewater percolates below the plant root zone. Although total quantities

of salt do not increase, the percolate may exhibit increased concentrations of TDS because of the removal of carriage water by evapotranspiration. As the quantities of percolate decrease in relation to total annual applications of wastewater, these TDS concentrations will increase. Under like conditions of evapotranspiration it must be stressed that similar increases in the mineralization of percolating water occurs in normal irrigation practice. While it is possible to protect the "living filter" from salt accumulation, the fate of the percolated salts must be carefully monitored and controlled to prevent an undesirable deterioration of ground and surface waters.

- d. Nutrients The two basic nutrients, phosphorus and nitrogen, are removed by various combinations of plant uptake and binding to the soil particles. Generally, nitrogen will be the limiting element on a short-term basis (yearly) whereas phosphorus will be the limiting element over a long period of time (50 or 100 years). Phosephates from applied wastewater ultimately end up either utilized by plants, or bound to soil particles as insoluable phosphates. Phosphate removal is generally accepted as complete in a well-managed soil system, especially at low application rates. Phosphate percolation usually occurs only when the soil capacity for assimilating the phosphates is reached. Reactions involving nitrogen in the soil are both very complex and very important, especially since nitrogen (in the nitrate form) seems to be the limiting element in land application systems. All of the major site components (plants, soil and micro-organisms) can provide active responses to nitrogen, depending on its form. Nitrogen can be applied to the soil in several forms, organic, ammonium or nitrate. About 90 percent of the total nitrogen in secondary effluent is in the inorganic form, as either ammonium or nitrate. The major opportunity for nitrate removal is by plant uptake. The amount removed is largely a function of the particular crop used. If more nitrogen is applied than can be used by the plants (or volatilized to nitrogen gas), the excess will percolate. Essentially all nitrogen percolating below the root zone is in the nitrate form. Some nitrate may be immobilized in the upper layers of the soil by incorporation into microbial cells and thus retained above the root zone as organic nitrogen. Ammonium nitrogen reaching the site has potential for two initial pathways. Some can be temporarily adsorbed by the soil particles. Fixation in less soluable forms by clay minerals is possible. The fraction temporarily held is available to micro-organisms. This microbial activity is also the second potential direct pathway. These aerobic organisms oxidize the ammonium nitrogen. The end product is still nitrate but the time lag inherent in the process is a definite benefit for overall removal efficiency. In effect the soils and organisms provide temporary storage for some of the nitrogen which is then gradually released for plant uptake during the non-spray rest periods.
- e. Heavy Metals The heavy metals considered are cadmium, cobalt, chromium, copper, iron, mercury, manganese, molybdenum, nickel, lead, and zinc. These heavy metals are considered by some

There are two basic concerns in dealing with heavy metals. First, that excessive amounts will percolate into underground water supplies or into recollected water thereby impairing their uses. Secondly, that the soluable fraction of these metals in the soil will be so great as to create excessive concentrations in plants which would either kill the plant or prevent its further use as harvested crop due to high toxicity. Several different mechanisms have been postulated for binding the metals in insoluable forms. Heavy metal cations are strongly adsorbed by organic matter which reduces their mobility. In addition, clay materials are often credited with having high cation exchange capability for holding onto heavy metals. These mechanisms are believed to be quite effective in permanently binding metals to the soil matrix.

INITIAL DEVELOPMENT OF ALTERNATIVES

WATER QUALITY ZONES

- 102. The San Francisco Bay system extends from the eastern end of Chipps Island at the city of Pittsburg, where the Sacramento and San Joaquin Rivers join, westward and southward to the mouth of Coyote Creek near the city of San Jose. The Golden Gate is about halfway between San Jose and Antioch and is the Bay's only direct connection with the Pacific Ocean. The Sacramento-San Joaquin Delta is roughly triangular in shape and extends from Chipps Island on the west, to the city of Sacramento on the north, and on the south to Vernalis on the San Joaquin River about 10 miles southeast of the city of Tracy.
- 103. Water quality zones were established in the San Francisco Bay-Delta system and its adjacent offshore ocean waters to permit differentiation and evaluation of water quality within different portions of the estuarine system. Five zones were established by the Corps of Engineers based on physical configuration factors and physical, chemical and biological water quality conditions. In all cases, the zones either correspond with, or were aggregations of, water quality zones developed for the State's Bay-Delta Program in the mid-60's. These five water quality zones are described in the following sections. In all cases, it was assumed that streams or rivers tributary to a zone become in fact part of that zone.
- a. Pacific Ocean Pacific Ocean waters offshore from and adjacent to the study area.
- b. South San Francisco Bay That portion of San Francisco Bay which lies south of the Oakland-San Francisco Bay Bridge.
- c. Central Bay Central Bay, as defined for this study, lies between the Oakland-San Francisco Bay Bridge and the Carquinez Strait Bridge and includes San Pablo Bay.
- d. Carquinez Strait Suisun Bay This zone includes Suisun Bay east of Carquinez Strait Bridge to the junction of the Sacramento and San Joaquin Rivers near Pittsburg.
- e. Sacramento San Joaquin Delta (as described in Paragraph 102).

BASE CONDITION

104. An existing or base condition was defined and used as a starting point for the development of the various wastewater management alternatives. The year 1975 rather than the current year was chosen as the Base Condition. Both the State Water Resources Control Board and the California Regional Water Quality Control Boards have directed certain dischargers to coordinate planning on a local subregional

- basis. As a result, interim water quality control plans have been developed for all basins in the study area and in some instances more definitive subregional plans have been developed. These plans specify short-term improvements for local dischargers and have been incorporated into present EPA project grant lists.
- 105. The year 1975 was chosen since it was a logical breakpoint in local planning activities. By 1975, nearly all of the short-term improvements which have been recommended by local subregional planning studies or required by the interim water quality control plans of the California Regional Water Quality Control Boards and the State Water Resources Control Board would either be in operation or under construction. The Base Condition is not a proposed wastewater management alternative. It is, rather, the expected progress which will be made by local effort in the next few years. Plate 4 shows the municipal wastewater facilities expected to be in operation or under construction by 1975.

POTENTIAL LAND APPLICATION SITES

- 106. Potential land sites were identified within and surrounding the study area for the application of treated wastewater. The entire area lying within the following boundaries was systematically reviewed to determine general areas containing potential wastewater application sites: the northern boundary being the Shasta-Siskiyou County border: the southern boundary being the Tehachapi Mountain range: the eastern boundary being the Sierra Nevada Mountain range; and, the western boundary being the Pacific Ocean. The following exclusionary criteria were used to initially exclude lands from consideration for wastewater application:
- a. All land areas having elevations greater than 1,500 feet were to be eliminated because any pumping head greater than 1,500 feet would not be economically feasible.
- b. In order to eliminate certain major legal and institutional problems and to insure that present natural open space was not reduced, essentially all land areas situated in national and state parks and national wildlife refuges were ex luded.
- c. All land areas projected to become urban by the year 2020 were excluded. This was done to insure that any potential site would not be located within an urbanized area.
- d. To insure proper vegetative growth and percolation of applied wastewater, all land areas having an identifiable hardpan layer or bedrock at a depth of less than four feet were excluded.

- e. To insure that possible flooding would not become an economic or environmental hazard, all lands in major flood plains were excluded.
- f. Small isolated landsites which were considerable distance from the nearest wastewater sources were also eliminated. It was assumed that land areas of 5,000 acres or less or of insufficient capacity to accept a total wastewater application rate of at least five million gallons per day per mile from the source would be uneconomical to develop.
- 107. As a result of using these initial screening criteria, 53 potential land application sites were identified. These 53 potential sites are shown on Plate 5. Based on location, preliminary environmental considerations, and engineering feasibility, 17 sites were chosen for additional study. These 17 potentially suitable sites were representative of most of the features such as elevation, soil conditions, native vegetation and irrigated agriculture found in the original 53. Also, the 17 sites represented a mix of interior valley and coastal areas. Further review of characteristics appropriate to accommodating a regional wastewater management solution resulted in the selection, for more detailed evaluation, of eight of these potentially suitable sites located within and immediately south of the San Francisco Bay and Delta Region. These eight sites, together with all other potentially suitable sites within the 12-County study area, are shown on Plate 6.
- 108. The eight selected sites are considered to be representative of the planning, design and cost factors which must be considered in developing systems for the large-scale land application of wastewater. These sites cover a gross area of about one million acres and assuming an average application rate of 6.5 acre-feet/acre/year would have the total capacity for the application of about 4.8 billion gallons per day of wastewater. A general description of each of the eight sites, including the rationale for site selection, follows:
- 109. Site No. $4^{1/}$ This site, adjacent to Suisun Bay, was selected to represent the opportunity for enhancing an existing wildlife habitat. The site has little or no potential for agricultural purposes because the existing soils have poor drainage characteristics. However, growth of plant foods for waterfowl could be achieved. The site includes the Grizzly Island Wildlife Management Area which is currently managed essentially as a waterfowl habitat. This site is an integral part of the San Francisco Bay system and does not appear to have an alternate location. The nearest major source of wastewater is the Fairfield-Travis Air Force Base complex in Solano County.

^{1/} The U.S. Bureau of Reclamation currently is conducting studies in this general area relative to the reuse of wastewater for marshland enhancement.



- 110. Site No. 5 This site, in Yolo and Colusa Counties, is the largest of the eight sites and includes a variety of land types. This site was selected because of the potential opportunities for the development of irrigated pastures, orchard enhancement, streamflow and groundwater augmentation, and general crop irrigation. The major features within this site are the Dunnigan Hills, the Cache Creek Valley and Sacramento Valley lands. Most of the area is under intensive farming, including general irrigated cropping and rice production. There are many similar sites in the Central Valley area. The nearest major source of wastewater to this site is Sacramento, 20 miles to the southeast.
- Ill. Site No. 18 This site, in Marin County north of Mt. Tamalpais and in Sonoma County south of the Russian River, was selected because it represents a typical north coast range location with adjacent dispersed major metropolitan areas. Land application of wastewater at this site offers the potential for the development of forests, the possibility of streamflow augmentation and, along with Site No. 28, would support the concept of preserving open space. The site includes the basins of Nicasio Creek, Walker Creek, Estero Americano and Salmon Creeks. The basin of San Antonio Creek is excluded because of poor soil conditions. The nearest major wastewater sources are Petaluma and the Santa Rosa Complex.
- 112. Site No. 21 This site includes three valleys in the vicinity of Healdsburg in Sonoma County: Alexander Valley, Knights Valley, and the Russian River Valley in the vicinity of Windsor. These valley areas are considered representative of a number of interior valleys in the north coast range. Land application at this site offers the potential for irrigation of existing crops, irrigation of forest areas, streamflow and groundwater augmentation and recreational enhancement. The nearest wastewater sources to this site are those in the vicinity of Santa Rosa and Healdsburg.
- 113. Site No. 27 This site, in Monterey and San Benito Counties, includes the Gabilan Creek Basin and easterly side of the Salinas Valley south from Salinas to near Solecad, including Quail and McCoy Creeks. The source of wastewaters for this site would be from the southern portion of the Study Area. Capacity in the site would be reserved for wastewaters generated in the Monterey Bay-Salinas Valley area. Land application in this area offers the potential for managed forests, particularly of Monterey pine, and also for irrigation of crops on a valley floor. Application of wastewater for irrigation could enhance agricultural activity and at the same time diminish or reverse the salt water intrusion into the area caused by excessive irrigation pumping.
- 114. Site No. 28 This site includes most of the southwest part of San Mateo County surrounding the Pescadero Creek area. It represents an area close to substantial urban development with potential for developing or improving redwood forests for commercial use and open space recreation needs. In addition, recreational use may be

further enhanced by streamflow augmentation. The potential sources of wastewater for this area would be from oceanside San Mateo County and South San Francisco Bay communities.

115. Site No. 42 - This site lies in Contra Costa County east of Mt. Diablo and includes the Marsh and Kellogg Creek Valleys, Deer Valley, and the forebays of the Delta-Mendota Canal and the California Aqueduct. It offers potential development for recreation and open space areas, forest lands and wildlife habitats. Site No. 42 is typical of a mix of irrigated agriculture and rolling foothills immediately adjacent to an expanding urban complex. The nearest major sources of wastewater for this area would be from Antioch and Stockton.

116. Site No. 43 - This site includes Union and Roberts Islands southwest of Stockton. Although the area has a high water table it appears possible that wastewater could be applied to the lands and recovered by means of drains and pumping in a manner consistent with present irrigation and drainage practices. The site is typical of the Delta Islands with large flat areas being currently farmed. The use of wastewater in this area could provide an excellent source of irrigation water as an alternative to riverflow and pumping from wells. The nearest major sources of wastewater for Site 43 are Antioch and Stockton.

COMPUTER COST OPTIMIZATION PROGRAM

Introduction

117. A methodology was necessary for determining possible least-financial cost plans involving land application for the collection and treatment of wastewater in the 12-County San Francisco Bay and Sacramento-San Joaquin Delta Region. Because of the complexity associated with the financial cost analysis of large wastewater systems, the use of advanced computational procedures involving computer technology was found desirable.

Program Theory

118. In structuring a network to represent the wastewater disposal system for a municipal area, a line or "arc" is assigned for each function or activity. An arc would be used to represent a treatment process or a group of processes, conveyance routes between source points, and outfall lines for final effluent discharge. By connecting all the arc nodes of a complete system, such that treatment processes and conveyance routes are in a technically feasible sequence, a network is formed. The basic objective in analyzing a network is to determine the flow in each arc, zero or otherwise, which will minimize the total system costs and at the same time satisfy all the established supply and demand constraints.

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119. Flows are assigned to each arc in the network and thus, a flow pattern is generated. Beginning with the source node, costs of collection, treatment, and disposal of wastewater in the direction of flow are computed at each node on the flow pattern from established cost curves. The program checks the feasibility of the solution by determining if all demands are met and all constraints are satisfied. The network program determines if optimal conditions are satisfied in each arc and if the total solution is optimized. The relative values of the node prices on the two extremities of the arc, the arc cost, and the flow define an optimal condition. When the solution is feasible and optimal conditions in any arc are satisfied, the flow in the arc is considered as a possible solution in further network analysis.

Cost Curve Development

120. The primary purpose of the cost curves is to serve as preliminary screening criteria with which the model could test numerous possible wastewater network alternatives and select the least costly for more detailed study. The cost curves developed and utilized in the model were based primarily on data from other water quality studies. The basic data were updated to reflect January 1972 cost levels (an appropriate date during the period of model development) and were modified to insure that various treatment methods and conveyance modes were being compared on a equal basis. All curves are in terms of total annual unit cost, including capital and operation and maintenance costs, with treatment costs expressed in cents/1,000 gallons, conveyance costs expressed in cents/1,000 gallons/mile, and pumping costs expressed in cents/1,000 gallons/foot of pumping head. At the beginning of the study, it was decided to develop costs based on three interest rates. These were 5-3/8 percent and two higher rates (7 and 10 percent). These higher rates were selected based on possible future economic trends.

Procedures for Alternative Development

121. There are two phases of data preparation which must be completed prior to utilization by the model. The first phase encompasses the engineering aspect. Source points must be established with actual locations, projected wastewater flows, and treatment systems. Additionally, all the source points must be interconnected with conveyance lines and the engineering data developed; i.e., length of conveyances through either rural or urban areas. Once these data have been developed, the second phase of preparation can be accomplshed, that of placing data in a format which is acceptable to the model. A standard 80-card column computer worksheet can be used for this purpose. In developing model networks for testing, almost any possible wastewater management regionalization is possible as long as the input network is less than 1,000 arcs. First, various system subregionalizations could be considered. The model can then indicate which conveyance routings would be of greater expense and thus, they could be immediately eliminated from further consideration. The

total system can then be tested as a single entity with any desired constraint included; i.e., limiting the total quantity of nutrients to be discharged in a specified discharge outfall or water quality zone, or placing a requirement on the system that a certain minimum level of treatment be established.

RANGE OF ALTERNATIVES EXAMINED

Wastewater

- 122. As previously discussed, a conceptual configuration of facilities for 1975 was developed to provide a common base for evaluating wastewater management alternatives. By agreement, this Base Condition configuration was used as a starting point for the development and testing of various alternatives.
- 123. Numerous alternative configurations consisting of combinations of land application and surface water disposal for wastewater generated in the San Francisco Bay and Delta Region were investigated by using a least-cost optimization mathematical mode. The 1975 Base Condition was used as a starting point from which all the alternative networks were developed. The Base Condition provided information on treatment plant consolidations, conveyance routings, and outfall locations. Alternatives were developed with the assumption that each would use some proportional amount of land treatment. Land application components ranged from an economical minimal use of land treatment to large-scale conceptual use. This last concept would insure that all wastewater generated would be treated by the land with no direct discharge to surface waterways.
- 124. Within each of the eight basic land application areas potential entrance points were established. With these data, the wastewater source points, land application sites, and discharge outfalls were interconnected with conveyance lines and various treatment schemes were placed at those source points where treatment plants could be constructed. These factors allowed the establishment of networks which could be refined into least-cost alternatives considering various constraints. Constraints considered included such items as water quality objectives (quantities of BOD, nutrients and heavy metals discharged to each water quality zone), minimum levels of treatment, maximum regionalization, and minimum or maximum quantities which could be treated at the land application sites. By these methods, five initial alternatives were developed.
- 125. The five initial alternatives were developed for further study and refinement. They were least-cost solutions for the amounts of land involved formulated with readily available information concerning environmental social, and public health considerations dealing with land treatment. It was anticipated that as more information became available, it would be used to revise these five alternatives. Also, because of the initial lack of data on sludge transportation methods and costs and the effects of various sludge components on the soil system, sludge components were not included.

- 126. Two different types of pretreatment systems for wastewater were considered in developing the alternatives. Both systems used a comparable biological secondary treatment process for use with the land application concept. In the first two alternatives, the wastewater is to be treated at existing or expanded Base Condition facilities by activated sludge units prior to conveyance to the land sites. Only treated wastewater is to be conveyed. In the second pretreatment system, which pertains to the last three alternatives, raw wastewater is conveyed to the land sites and treated in aeration lagoons prior to the storage and spray application on the land. It was assumed that either pretreatment system would provide comparable constituent removal for subsequent land treatment. These five initial alternatives are described in the following paragraphs.
- 127. Technical Alternative A This alternative attempts to maximize the incorporation of 1975 facilities thereby minimizing the incremental capital investment required for the future. Under this alternative about 50 percent of the region's preliminary year 2000 wastewater flow is conveyed to land application sites following secondary treatment in existing or expanded Base Condition treatment plants. Land requirements for this alternative were approximately 130,000 acres. Reservoirs, with capacity for about 50 percent of the total yearly incoming effluent, are provided at the land application sites to provide storage during the four-month period when spray application to the land cannot be accomplished. Seven facilities provide tertiary treatment for wastewaters being discharged to surface waters.
- 128. Technical Alternative B Alternative B also emphasizes the retention of the planned 1975 facilities. This alternative makes greater use of land treatment and less use of tertiary treatment than does Alternative A. Under this alternative over 60 percent of the region's preliminary year 2000 wastewater flow is conveyed to land areas following secondary treatment for storage and subsequent treatment by land application. Approximately 145,000 acres of land are required for spray application. The remainder of the wastewater is discharged to surface waters after tertiary treatment in five regional treatment plants.
- 129. Technical Alternative C This alternative presents a regional configuration which tends to place greater reliance on land treatment than does either Alternative A or B. Many of the 1975 treatment facilities are converted to pumping stations and all wastewater destined for land application receives secondary-level treatment in aeration lagoons at the land application sites. This secondary effluent is conveyed to storage reservoirs and finally receives advanced treatment by land application. More than 65 percent of the region's preliminary year 2000 waste flow is applied to land for

treatment under this alternative. About 175,000 acres of land are required for spray application. In this alternative about 35 percent of the region's year 2000 wastewater flows receives tertiary treatment at seven facilities prior to discharge to surface waters.

- 130. Technical Alternative D Alternative D is similar to Alternative C except that fewer of the Base Condition treatment facilities are retained and more land application is proposed. Secondary treatment before spray application to the land would be accomplished in aeration lagoons at the land sites. Under this alternative, over 80 percent of the region's preliminary year 2000 wastewater flow is conveyed to land areas for secondary treatment, storage, and spray application to land. About 205,000 acres of land are required for spray application. Less than 20 percent of the region's wastewater flows discharge to surface waters after tertiary treatment.
- 13]. Technical Alternative E This alternative presents a conceptual regional land treatment configuration. It allows for no direct discharge of treated wastewater to the Pacific Ocean or San Francisco Bay and Delta Estuary. Raw sewage is conveyed to the land areas where secondary treatment is accomplished by aeration lagoons. The secondary effluent is conveyed to storage reservoirs and finally receives advanced treatment by spray application to the land. Approximately 255,000 acres are necessary to manage the region's year 2000 wastewater flow.

PUBLIC INVOLVEMENT

Introduction

132. With broadening public interest in the development of water resources, planners recognize that social and political feasibility are as essential a part of the planning process as environmental, engineering, and economic considerations. The planner considers the limits of social and political feasibility throughout the entire planning process. Agreement between the planner and the community upon the existence of a problem which demands a study of feasible solutions is extremely important. The purpose of public involvement in planning is to achieve mutual understanding and a reasonable consensus of agreement with the community by means of constant communication with individuals and organizations who in the end are the determining influences. Effective public participation in water resources development is based on the recognition that those affected by planning should have the opportunity to influence and shape the plans. The operational realization of this is accomplished by involving the public in planning through communication processes including information, evaluation, feedback, and subsequent plan revisions.

Objectives

133. As a basis for development and organization of public involvement in planning, specific program objectives are required. These objectives are set out as follows:

- a. To present information which will assist the public in defining their water resources needs and to provide the public an opportunity to influence and shape the formulation of planning alternatives and to express preferences in choosing a course of action.
- b. To provide the planners with definite channels through which to obtain information on public goals, priorities and preferences regarding planning alternatives.
- c. To coordinate related land and water resources planning with other Federal, State, and local agencies.
 - d. To explain planning processes and procedures.
- e. To minimize conflicts in determining and meeting the needs and preferences of the various communities and groups within the public interest.
- f. To use information obtained in developing plans to meet the desires of the public.

Public Involvement Program

- 134. The initial public involvement program for this study consisted of joint public meetings with the State Water Resources Control Board and the Environmental Protection Agency, and workshop sessions with special groups representing environmental and agricultural interests. Prior to each public meeting, notices of the meeting, brochures for background information, and copies of the joint agreement for interagency water quality management planning between the State of California, the Environmental Protection Agency, and the Corps of Engineers were distributed. Such information also was distributed to Congressional representatives, Federal agencies, State representatives, county and local government, industries, utilities, organized local interest groups, the news media, and individuals interested in wastewater management planning.
- 135. The first public meeting was held in Martinez, California, on 17 April 1972 at the Contra Costa County Administration Building. The second meeting was actually a series of three successive sessions. The first session was held on 21 September 1972 at the State Resources Agency Building in Sacramento, California. The second was held on 25 September 1972 at the Marin County Civic Center in San Rafael. The third meeting was held at the San Jose City Hall on 28 September 1972.
- 136. Meetings were jointly chaired by the Corps, the State Water Resources Control Board, and the Environmental Protection Agency. An introductory presentation was made at the start of each meeting which expanded on information previously distributed. Statements from interested parties were then requested. A complete record of the hearings was made including names of those in attendance for future review and further consideration in planning efforts.

These records are available for review in the Corps' San Francisco District Office. Also, they are to be furnished higher echelons for information.

- 137. The basic purpose of a workshop is to generate an input of local needs, desires, and goals for the planning study. An additional objective is to lay the ground work for continuing feedback from local interests in developing and assessing planning alternatives.
- 138. Three environmental workshop sessions were held with various San Francisco Bay environmental groups. Advance information for discussion was mailed to the interested organizations and individuals and included an environmental summary. Workshop sessions were held on 11 October and 15 November 1972 and 17 April 1973. In addition, a workshop session with agricultural interests was held on 21 November 1972 at the University of California in Berkeley for representatives of the University of California's Agricultural Extension Service. The structure of the meeting and materials furnished were the same as for the environmental workshops.
- 139. The initial public involvement program produced testimony that indicated general concern regarding the large-scale land application of wastewater and sludge and the Corps' initial alternatives. The major concerns and observations resulting from the public involvement program are as follows: There was general concern regarding environmental preservation. Also, the massive disruption of community structure and the loss of tax base was of concern to many residents living in some of the identified land application site areas. Many participants desired additional information on groundwater effects from the land application of effluent. There was concern regarding the quality of effluent prior to land application, the potential for public health problems, and the fate of heavy metals and nutrients in the soil mantle. Monterey and Yolo Counties interests voiced strong opposition to the use of land areas in their counties for the application of wastewater and sludge. In addition, Monterey County interests felt that wastewaters should not be transported into their area from the San Francisco Bay and Delta Region. Favorable comments regarding agricultural benefits came from individuals and agencies in San Joaquin, Marin and Napa Counties. Marin County expressed some concern regarding high application rates and indicated that reduced application rates would allow additional agricultural acreage to be benefited. There were several suggestions, including one from Napa County, that a demonstration project or "pilot plant" should precede any decision for the implementation of the land application concept.
- 140. The final phase of the public involvement program consisted of the wide distribution of a public information brochure in December 1973. The brochure highlighted the results of the Corps' study and presented information on land application concepts for the consideration of the State of California in its comprehensive water quality planning program. Comments on the public information brochure have been provided to the State of California and are included in a separate appendix.

FINAL WASTEWATER MANAGEMENT ALTERNATIVES

INTRODUCTION

- 141. The objective of the public involvement program was to provide a framework by which the public could actively participate in the study effort. The public meetings not only provided the opportunity to keep the area's residents informed of the study's scope and status but also to obtain their reaction to various alternatives being developed. As a result of the public meetings and workshop sessions, valuable information was obtained by the Corps of Engineers to develop final wastewater management alternatives which reflected, as much as possible, the desires of the public. Also, as comments from the public were being evaluated, the data used to develop the initial technical alternatives were finalized and updated based on more recent information.
- 142. Several important areas of consideration developed as a result of the September 1972 public meetings. Various comments and suggestions from interested agencies and the public-at-large were used in revising the alternatives. For instance, it was recommended that additional emphasis be placed on the first phases of the various subregional plans being completed within the San Francisco Bay Area by various engineering consulting firms working for the cities in the study area and that the Corps' wastewater management alternatives be more closely aligned with the State's Interim Basin Plans.
- 143. Two important considerations also presented at the public meetings involved Sites 27 and 28. The U.S. Geological Survey noted that Site 28 was located in an area of San Mateo County considered to be susceptible to landslide deposits. This information was used in refining the usable land acreage in Site 28. As a result, Site 28 was reduced from an initial 114,600 acres to 14,000 acres.
- 144. Local interests in the Monterey County area objected to the use of Site 27 for the treatment of wastewater originating from outside their area. Due to their insistence that Site 27 not be used as a primary land application area, the site was used only as a possible add-on site to the basic alternatives. The site was retained to provide flexibility and additional options for dischargers in the southern portion of the study area and to permit evaluation of the concept of interbasin transfer of wastewater.
- 145. Another important aspect of alternative development presented at the public meetings was that of possible staging effects. Generally, it was suggested that such a high tertiary level of treatment for the wastewater being directly discharged to surface waterways might not be required. If this were the case, it would then be possible to reduce the level of treatment required for the year 2000 with the ultimate goal of providing the full tertiary level of treatment for the year 2020. It was suggested that an intermediate-level alternative be developed to accommodate a lower degree of treatment. This concept

was utilized as final alternatives were developed. With such systems, lower degrees of treatment were proposed and receiving water quality conditions were held to projected 1975 levels. These treatment systems would be used prior to the use of a full tertiary treatment system such that a staging of the levels of treatment would be developed from the Base Condition through a conceptual year 2020 Master Plan.

146. As a final comment, it was noted that the wastewater being collected by underdrains in each land site would be of a high quality and could have numerous reuse potentials. Various reuse opportunities were investigated for the utilization of this reclaimed water as the final alternatives were developed.

REVISION OF DESIGN DATA

Municipal Wastewater Flows and Constituents

147. The final municipal wastewater flow data did not significantly change from the initial data used. After an analysis was made of projected municipal flows from the completed local subregional reports, it was ascertained that the initial data would be satisfactory. The wastewater constituent data used initially was, however, changed. The basis for changing these data was the completed subregional reports. These reports furnished current data on municipal flows and constituents. Table 6 presented earlier summarizes the finalized municipal wastewater flows. Final municipal wastewater constituent loadings by county are presented in Table 14.

Industrial Wastewater Flows and Constituents

148. The initial industrial wastewater data were based primarily on the U.S. Army Corps of Engineers' Permit Program. From an overall conceptual viewpoint, the initial projection of data did not take into consideration such items as economic and production projections or industrial output. In most regional studies, projections are based on population, employment, and income estimates. The final industrial flow and constituent data were based on these essential items. The Corps contracted with the Lawrence Berkeley Laboratory for the development of such data based on established industrial statistical averages.

149. The emphasis on regional water planning has resulted in various planning regions being designated and data developed for these areas which present population projections along with estimates of earnings for various major industrial sectors. The method used was to relate water and wastes to industrial output once employment and earnings data had been furnished. The U.S. Bureau of Census provided data on water use by manufacturing industries for the nation and for various national industrial water-use regions. These data were used to develop a base year (1967) growth rate situation. From this base year, employment projections by county were developed and related to wastewater flows through projected productivity for each industry. Factors were developed to account for advances in luture process technologies and recycling of both cooling and process water.

TABLE 14 $\label{eq:projected} \mbox{PROJECTED FINAL MUNICIPAL WASTEWATER CONSTITUENT LOADINGS $1/$}$

COUNTY		CONSTI	TUENTS (mg	g/1)	
	BOD	TN	TP	GHM	TDS
Alameda	209	35	14	2.2	700
Contra Costa	230	40	11	2.2	700
Marin	240	30	14	1.6	700
Napa	270	35	15	2.0	700
Sacramento	275	35	14	1.9	700
San Francisco	245	35	14	2.5	700
San Joaquin	280	35	14	1.1	700
San Mateo	275	35	14	2.2	700
Santa Clara	272	35	14	2.5	700
Solano	274	35	15	1.9	700
Sonoma	280	35	14	1.9	700
Yolo	270	35	14	2.0	700

^{1/} Based on year 2000 wastewater flows.

- 150. A total of eight industrial water-use strategies were then developed to account for various years when the advances in technology and recycling would occur. From an analysis of these data, a selected situation could be formulated which would represent the most probable condition expected to occur. The following strategies were developed and analyzed.
- a. Strategy Number 1 To obtain the maximum projected water use values, it was assumed that future water intake and wastewater flows would be based on current data and information. It was further assumed that there would be no additional recycling of water or general improvements in the technology of water reuse.
- b. Strategy Number 2 (Process Water) It was assumed that by 1975 a 50 percent improvement toward the maximum possible level of recycling of process water would be achieved in all industries and by 1985 the maximum possible recycling of process water would be reached in all industries. It also was assumed that by 1985 a new improved technology for process water would be implemented in all industries. The cooling water systems were assumed to remain unaffected by improvements in recycling or new technology.
- c. Strategy Number 3 (Cooling Water) It was assumed that by 1975 a 50 percent improvement toward the maximum possible level of recycling of cooling water would be achieved in all industries and by 1985 the maximum possible recycling of cooling water would be reached in all industries. It was assumed that by 1985 a new improved technology for cooling waters would be implemented in all industries. The process water streams were assumed to remain unaffected by improvements in recycling or new technology.
- d. Strategy Number 4 (Process and Cooling Water) It was assumed that by 1975 a 50 percent improvement toward the maximum possible level of recycling of process and cooling water would be achieved in all industries and by 1985 the maximum possible recycling of process and cooling water would be reached in all industries. It also was assumed that by 1985 a new improved technology for process and cooling water would be implemented in all industries.
- e. Strategy Number 4A (Process and Cooling Water) It was assumed that by 1975 a 25 percent improvement toward the maximum possible level of recycling of process and cooling water would be achieved in all industries. This value would gradually be increased to 38 percent by 1980, 50 percent improvement by 1985, and a maximum level of recycling would be achieved in 1990. It was also assumed that by 1985 a new improved technology for process and cooling water would be implemented in all industries.
- f. Strategy Number 4B (Process and Cooling Water) It was assumed that by 1985 a 50 percent improvement toward the maximum possible level of recycling of process and cooling water would be achieved in all industries. This value would gradually be increased to 75 percent improvement by 2000 and the maximum level of recycling would be

achieved in 2010. It was also assumed that by 2000 a new improved technology for process and cooling water would be implemented in all industries.

- g. Strategy Number 4C (Process and Cooling Water) It was assumed that by 1985 a 50 percent improvement toward the maximum possible level of recycling of process and cooling water would be achieved in all industries and by 2000 the maximum possible recycling of process and cooling water would be achieved in all industries. It was also assumed that by 2020 a new improved technology for process and cooling water would be implemented in all industries.
- h. Strategy Number 5 To provide a lower bound to the possible level of water use in the more immediate future, it was assumed that the maximum level of recycling and new technology for both process and cooling water would be instituted in all industries by 1975.
- 151. To provide for a probable situation which may occur due to recent technological advancements and environmental legislation, a combination encompassing industrial water use strategies 4, 4A and 4B was selected for projection purposes. Also, due to the low concentration of anticipated waste constituents in cooling water and the probability of maximum reuse, cooling water from Contra Costa County industries was removed from the discharge flow. As a result, Table 15 summarizes the projected industrial wastewater discharge flows based on the following strategies:
 - a. 1975 Based on Strategy 4A
 - b. 2000 Based on Strategy 4B
 - c. 2020 Based on Strategy 4
- 152. Estimates of the gross industrial waste loads for the period 1970 to 2020 were based on the assumption that the amount of waste now generated (1970) per constant dollar would remain reasonably constant in the future. Projections for the period 1970 to 2020 for each county were developed. It is important that the results reported be interpreted and applied with the understanding that they represent gross waste loadings. Based on trends evidenced in recent environmental legislation, these gross waste loadings must be reduced prior to discharge into any regionalized system. It has been assumed that industries would be required to reduce waste constituent loadings by 65 percent in 1975 and 90 percent by 2000 through various industrial treatment methods. These assumed reductions represent projected lower limits of treatment which industry, as a whole, may have to attain prior to discharge. Lower limits were assumed for the purpose of providing an unfavorable situation which a combined municipal-industrial system must care for in assuring proper treatment of all wastewater. In this manner, each final alternative to be developed would provide acceptable treatment for the total municipal-industrial flow under conditions less than optimal. This provides a built-in safety factor.

TABLE 15

PROJECTED INDUSTRIAL WASTEWATER FLOWS

	FLO	W/YEAR (MGD)	
COUNTY	1975	2000	2020
Alameda	26.5	34.3	50.6
Contra Costa	134.1	174.5	258.0
Marin	1.4	3.8	8.9
Napa	16.3	28.4	44.6
Sacramento	15.5	20.5	29.3
San Francisco	4.8	6.6	9.8
San Joaquin	21.0	24.5	33.6
San Mateo	14.8	25.7	39.6
Santa Clara	21.0	30.1	41.7
Solano	7.4	8.2	11.0
Sonoma	5.0	7.6	10.7
Yolo	9.9	10.4	13.5
Total	277.7	374.6	551.3

153. With both municipal and industrial flows formulated, it is then possible to develop the total flows not only by counties but also for each major wastewater source. The finalized municipal and industrial flows and constituent loadings used are reported in Table 16 and Table 17, respectively.

Land Availability

- 154. The initial data used for each potential land application site were preliminary in nature and were being refined by a consulting engineering firm. Based on a detailed analysis, including environmental concerns and physical conditions, the eight selected land application sites were refined not only in configuration but also in usable acreage for wastewater and sludge application. The initial data for each land site were based on a preliminary engineering and environmental scan. The finalized data were based on detailed land site evaluations.
- 155. As a result of the revised data, certain preliminary wastewater conveyance routings had to be changed as well as land area treatment facilities relocated. Also, detailed wastewater application rates for each of the land application sites were determined. These application rates, based on soil structure, vegetative cover and water quality conditions were then used to determine maximum quantities of wastewater each site would effectively treat. A summarization of the finalized land application data (usable acreage and maximum capacity) are shown in Table 18.

Energy

- 156. Data were obtained from the literature to determine electrical requirements (total kilowatt hours) for the various treatment process configurations used in this study. These data follow:
 - a. Physical-chemical treatment 795 kw-hr/day/MG
 - b. Secondary treatment 671 kw-hr/day/MG
 - c. Advanced treatment (Type A) 917 kw-hr/day/MG
 - d. Advanced treatment (Type B) 1,383 kw-hr/day/MG
 - e. Advanced treatment (Type C) 1,247 kw-hr/day/MG
 - f. Tertiary treatment 3,041 kw-hr/day/MG
 - g. Land treatment (Type X) 836 kw-hr/day/MG
 - h. Land treatment (Type Y) 2,329 kw-hr/day/MG

These values would approximate the total requirements for operation of the wastewater treatment facility. Included in these values are accessory equipment required at any treatment plant; i.e., pumps, instrumentation facilities, and chemical feed systems.

TABLE 16
FINAL MUNICIPAL AND INDUSTRIAL FLOWS

		FLOW (MGD)	
COUNTY	1975	2000	2020
Alameda	166.1	219.4	273.0
Contra Costa	199.1	283.2	399.2
Marin	23.5	42.2	61.7
Napa	25.4	48.7	75.0
Sacramento	115.2	169.3	208.0
San Francisco	107.9	114.0	124.4
San Joaquin	76.6	114.2	141.3
San Mateo	69.0	91.0	114.2
Santa Clara	160.7	270.7	374.0
Solano	31.6	59.0	112.5
Sonoma	23.3	46.1	64.7
Yolo	25.0	37.7	54.5
Total	1,023.3	1,495.5	2,002.5

TABLE 17 FINAL MUNICIPAL AND INDUSTRIAL CONSTITUENT LOADINGS (mg/1) 1/

County	BOD	TN	TP	<u>GHM</u>	TDS
Alameda	182	30	12	3.2	600
Contra Costa	102	18	5	1.3	330
Marin	219	27	13	5.1	645
Napa	120	17	9	9.9	382
Sacramento	249	31	12	3.1	625
San Francisco	234	33	13	3.3	664
San Joaquin	229	27	11	3.8	567
San Mateo	202	26	11	3.6	524
Santa Clara	248	31	12	4.2	630
Solano	244	31	13	3.1	615
Sonoma	244	30	12	3.9	596
Yolo	209	26	10	8.6	526

 $[\]underline{1}/$ Based on year 2000 wastewater flows.

TABLE 18
FINALIZED LAND APPLICATION DATA

Land Area	Maximum Capacity 1/ (MGD)	Total 2/ Usable Acreage
28	64	14,000
27	275	58,000
42	228	38,000
43	236	54,000
05	952	192,000
04	15	3,700
21	175	45,000
18	240	54,000
TOTAL	2,185	459,000

^{1/} Assuming an application rate of 4.5 acre-feet per acre per year for crops and 9.0 acre-feet per acre per year for pastures.

^{2/} Round.

157. It was assumed that methane, a gas produced during sludge digestion, could be recovered and used in place of most natural gas requirements at the treatment plants. Proper anaerobic digestion will produce a gas by-product with 65 to 70 percent methane, 25 to 30 percent carbon dioxide, and approximately 1 to 50 percent hydrogen sulfide, nitrogen, and hydrogen. Once the impure gases have been removed, methane can be collected and used as fuel for engines which drive blowers, compressors and pumps; and to provide heating of the digester sludge and plant facilities. Natural gas would be necessary only for start-up and emergency conditions.

Chemicals

158. Various chemicals would be required to support the treatment plant operations and to insure that proper removal of constituents is maintained. Recovery of certain chemicals (lime and carbon) would be economically feasible on large capacity treatment plants. Criteria for determination of the chemical requirements were obtained from the literature.

DEVELOPMENT AND DESCRIPTION OF FINAL WASTEWATER MANAGEMENT ALTERNATIVES

Development of Wastewater Management Alternatives

159. As a result of the public input and the revised design data, six final wastewater management alternatives were developed incorporating two regional wastewater management concepts (B-Series and D-Series) for the land application of wastewater and sludge. Under the B-Series concept of alternatives, wastewater would be treated by a biological secondary process (activated sludge) prior to transmission to a designated land area. No raw wastewater would be conveyed to the landsites. Once the treated wastewater enters a land area, it would undergo channel aeration to remove any septic odors prior to storage in reservoirs and land application. Under the D-Series concept of alternatives, raw wastewater would be conveyed to designated land areas. Upon entrance into the site, the wastewater would be treated in aeration lagoons prior to storage and spray application (see Figure 8).

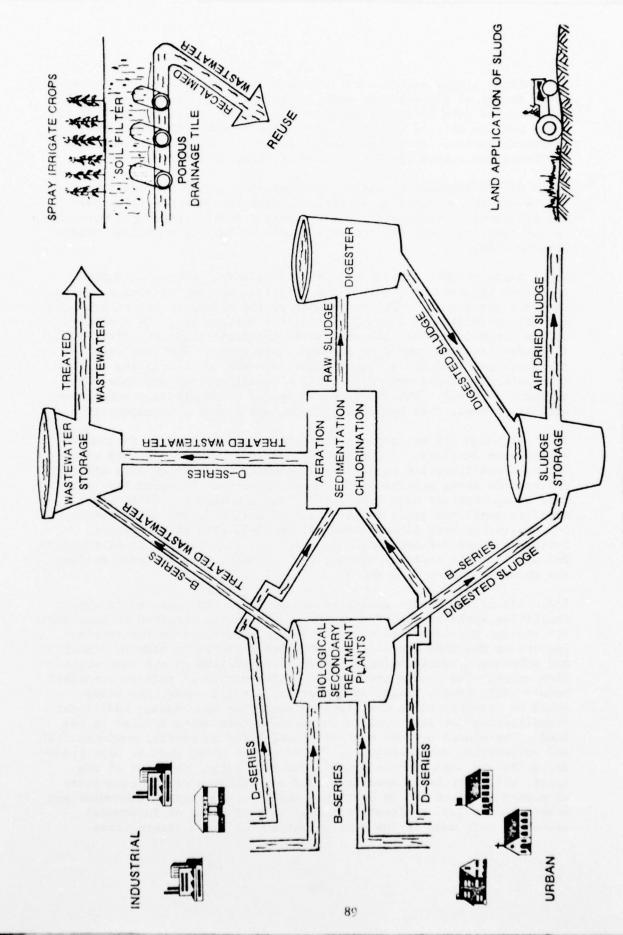
160. The basic B-Series concept of alternatives retains most of the current investment in conventional sewage treatment plants and provides an initial level of treatment prior to conveyance to land application areas. The D-Series concept of alternatives, on the other hand, converts most of the Base Condition treatment plants to pumping stations and transports raw wastewater to the land areas for treatment. Within each series concept, there are three separate alternatives which stress various aspects of treatment and conceptual planning. In Alternatives B-1 and D-1, full tertiary treatment is provided for water-oriented discharges prior to disposal. The B-2 and D-2 alternatives provide a lower level of treatment for wastewater being discharged to surface water bodies, as was suggested at the public meetings. These two alternatives, however, allow to more pollutants to reach surface

waters than were allowed by the 1975 Base Condition facilities. The B-3 and D-3 alternatives are variations of the basic B-1 and D-1 alternatives. These two systems propose and explore the interbasin transfer of wastewater by using an additional land site in the Monterey-San Benito County area.

- 161. All alternatives provide a complete regional system for the disposal of the Region's sludge by land application methods. In the B-Series concept of alternatives, digested sludge from all treatment plants enters land-site lagoons where sludge is air dried for two years before application to land. In the D-Series concept of alternatives (Figure 8), sludge from the sedimentation basins is digested and added to storage. The sketch on page 89 conceptually shows these two different approaches in applying wastewater and sludge to the land.
- 162. Also developed was a full tertiary treatment system which discharges treated effluent directly to surface waters. In developing this system, the Corps of Engineers made no studies relative to the need for any specific level of treatment. This is the responsibility of the State of California. The levels of treatment shown were assumed by the Corps of Engineers, as discussed previously. With such a configuration, sludge could be handled as previously discussed for the B-Series concept of alternatives.

Development of Sludge Systems

- 163. Most of the wastewater treatment processes used produce a solids concentration as a result of chemical or biological reaction in the treatment of sewage. This solids concentration, termed sludge, refers to the settleable waste solids removed in the treatment of wastewater. These include:
- a. Screenings the largest solids found in wastewater such as rags, wood, rocks and large organic materials.
- b. Grit the small, coarse particles of sand, gravel, and other minute pieces of mineral matter: also includes a variety of items such as coffee grounds, seeds, and similar materials which are not of mineral origin.
- c. Skimmings the floatable portion of the sludge such as oils and grease.
- d. Organic solid sludges the suspended and larger colloidal organic waste solids from the biological treatment units.
- e. Lime sludges produced by high-lime treatment for the removal of phosphates.
- 164. Sludge must be rendered into a form which is suitable for the method of transportation being utilized for its transport to a final disposal location. Such processes could consist of thickening, anaerobic or aerobic digestion, air-drying on sand beds, dewatering by centrifuges or vacuum filters, or incineration. Each process will produce a sludge with a different composition; i.e., total solids content, percent organic matter and inorganic characteristics.



LAND APPLICATION SYSTEMS

Preliminary sludge alternatives were not formulated because the wastewater technical alternatives were for initial planning purposes with only limited data being available on sludge transportation methods and costs and the effects of sludge components on the soil within the land treatment system. It was planned that the sludge alternatives would be formulated during the development of final alternatives.

- 165. Within the Base Condition configuration (1975) are various processes for the disposal of sludge. As with the Base Condition for the treatment of wastewater, these sludge treatment processes were used as the starting point for the development of various technical sludge alternatives.
- 166. Based on data presented in the literature, anaerobic sludge digestion appears to be one of the principal methods of sludge treatment for the future. This is because of the volume reduction achieved and the production of a usable resource methane gas. As a result, it was assumed that at each wastewater treatment plant the first stage in sludge treatment would be anaerobic digestion. The next step in the development of the sludge alternatives was to analyze the various transportation modes and consolidation configurations possible for ultimate disposal. The four basic modes of transportation considered were truck haul, rail haul, barge haul, and pipeline transportation.
- 167. Although six wastewater alternatives and a tertiary treatment system were developed, there was no need to develop a separate system for each configuration to handle the sludge. There were only minor differences among several of the configurations. Consequently, only four sludge systems were developed. Sludge System S-1 (with minor modifications) can apply to Alternatives B-1, B-2, and B-3. System S-2 applies to both Alternatives D-1 and D-2, with minor changes. Systems S-3 and S-4 are unique in that they apply solely to Alternative D-3 and the full tertiary system, respectively. These sludge systems are shown on Plates 7, 8 and 9.
- 168. All of the sludge generated at secondary and advanced treatment facilities would be digested at the plants and be conveyed to land areas for storage and land application. Sludge produced from the aerated lagoons at the land application areas would similarly undergo digestion and subsequent conditioning prior to being applied in the land application areas. The sludge systems use a combination of various transport modes; rail, truck, barge, and pipeline. In all cases, the sludge would be transported in the digested condition and undergo additional "conditioning" at land application areas before being applied to the land. The sludge systems were developed based on social, environmental and engineering considerations. It should be noted that as more transfer modes are used such as truck to rail to barge, the cost of the system will increase. However, based on estimates of the quantities of sludge produced and to be transported, transportation economics and access to the land application areas, several forms of intermodal transfers were used in the development of the final alternatives.

Alternative and Site Development Descriptions

169. Alternative B-1 - Wastewaters would either undergo local tertiary treatment and discharge to surface waterways or would receive biological secondary treatment and be conveyed to seven land areas for storage and subsequent land application. A total of 945 MGD (65 percent of the year 2000 flow) would receive tertiary treatment and 510 MGD (35 percent of the year 2000 flow) would be applied to the land areas. Plate 10 depicts the configuration of conveyance lines and wastewater management facilities for Alternative B-1. It should be noted that plates depicting the alternative wastewater management configurations and sludge systems do not show the revised acreages at land application sites. Only the gross outline of the initial land application sites are shown. Areas suitable for wastewater and sludge application are shown on the site development plates.

170. Wastewaters from all sources in the South San Francisco Bay area (550 MGD) would be combined for treatment in five tertiary plants and discharged between Dumbarton Bridge and the San Francisco-Oakland Bay Bridge. There would be two ocean discharges totalling 120 MGD: less than 1 MGD in the Bolinas-Stinson Beach area and the remainder from the San Francisco complex. In addition, 9 MGD from the Gilroy-Morgan Hill area would be conveyed to the Pacific Ocean via local streams. In Central San Francisco Bay between the Bay Bridge and the Carquinez Strait Bridge, 167 MGD would be discharged at three tertiary facilities. There would be no discharge between the Carquinez Strait Bridge and Chipps Island. Approximately 99 MGD of tertiary effluent would be discharged in the Delta east of Chipps Island. Wastewaters from the Livermore Valley area would receive tertiary treatment and be discharged to a local manmade lake in Doolan Canyon. Wastewater constituents discharged to the various waster quality zones under this alternative are shown in Table 19.

171. Wastewaters from northern Sonoma and most of Napa Counties would be treated in local biological secondary treatment plants prior to conveyance to Site 21 for land application. Wastewaters from southern and central Sonoma County and all of Marin County, less the Bolinas-Stinson Beach area, would be conveyed to Site 18. Land Site 4 would receive treated wastewater from the Fairfield-Travis AFB area. The flow from northern Solano, Yolo, and northern Sacramento Counties would be conveyed to Site 5. Southern San Joaquin County would utilize Site 43 while eastern Contra Costa County and the city of Benicia would use Site 42. The western portion of San Mateo County would convey its treated wastewater to Site 28.

172. Site development details are discussed below for the land treatment of wastewater at the seven application sites. Land application data, including waste quantities and major acreage requirements by site, are shown in Table 20. Total land requirements in the vicinity of the landsites are about 156,500 acres.

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PLATE 10B

TABLE 19

WASTEWATER CONSTITUENT DISCHARGE SUMMARY

Alternative B-1

(Discharge to Surface Waters)

		Base Condition	dition				Alt	Alternative B-1	e B-1	
LOCATION	FLOW	ВОД	ZI.	TP	CHIM	FLOW	BOD	IN	TP	GHM
PACIFIC OCEAN	115	57.6	57.6 13.8 3.8	3.8	1.9	129	2.1	9.0	0.1	9.0
SOUTH SF BAY	372	58.6	31.1 22.7	22.7	6.6	550	5.1	2.1	7.0	2.4
CENTRAL SF BAY	130	24.9	24.9 12.5 7.5	7.5	3.3	167	2.8	0.8	0.2	0.7
CARQUINEZ STRAIT - SUISUN BAY	107	16.9	16.9 10.1 6.5	6.5	2.9	0	0	0	0	0
DELTA	207	27.0	27.0 14.7 9.7	6.7	4.3	66	1.5	0.5	0.1	0.4
TOTAL	931	185.0 82.2 50.2	82.2	50.2	22.3	945	11.5	7.0	8.0	4.1

NOTES:

Flow reported in MGD.

Constituents reported in 1,000 lbs/day.

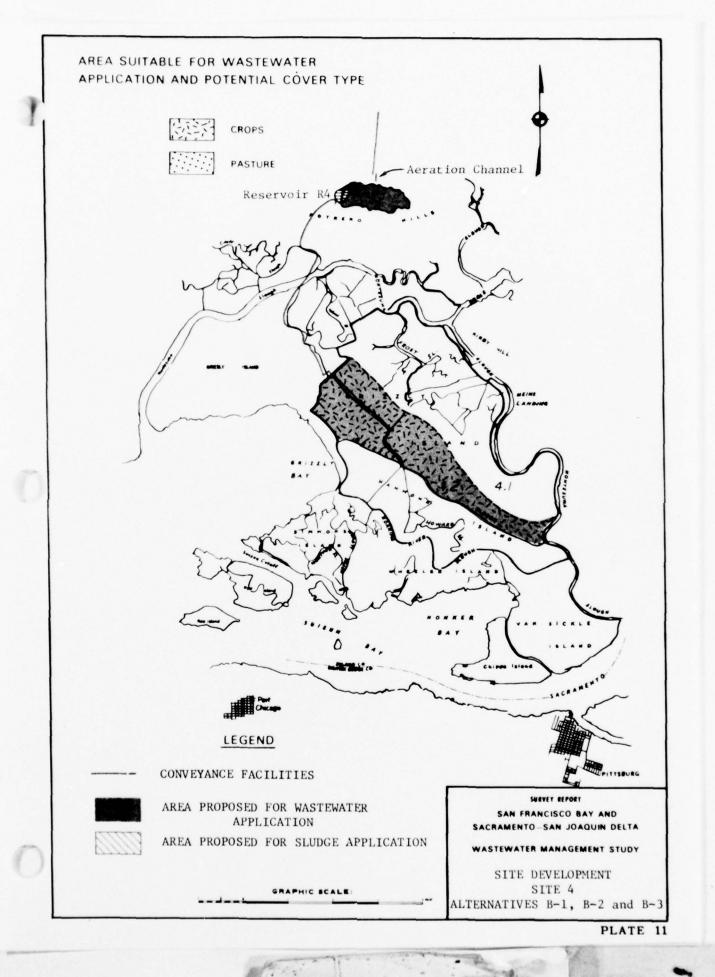
TABLE 20

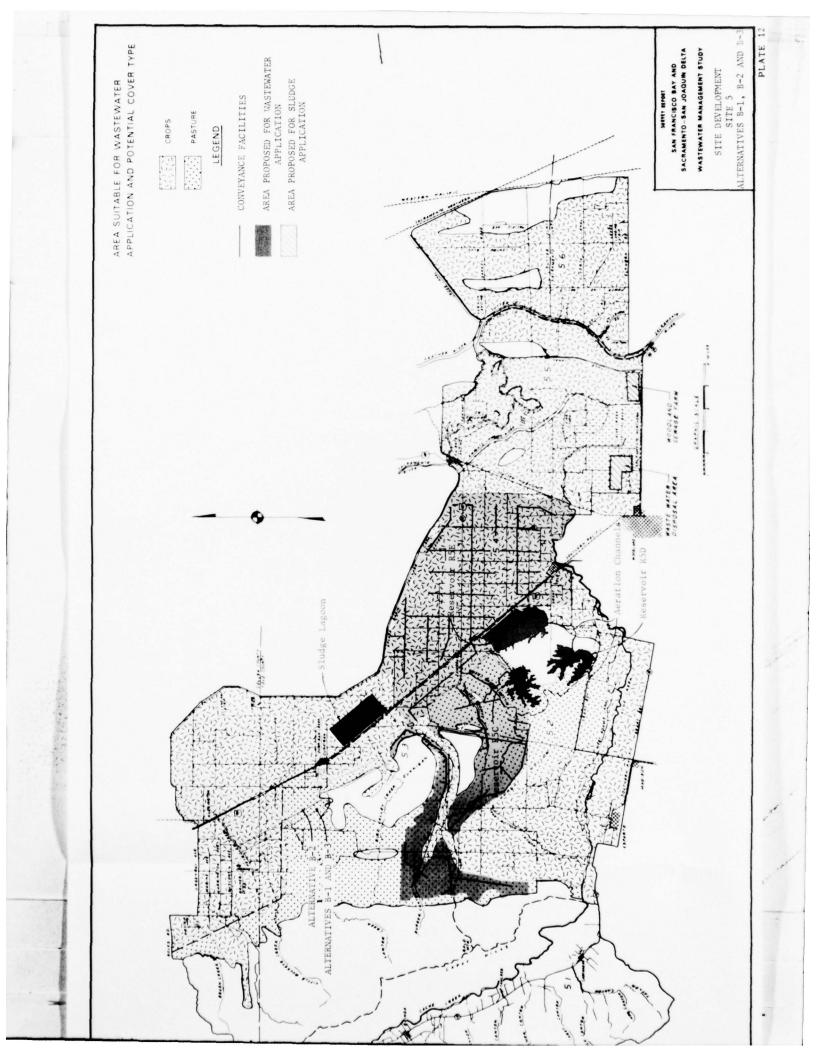
LAND APPLICATION DATA - ALTERNATIVE B-1

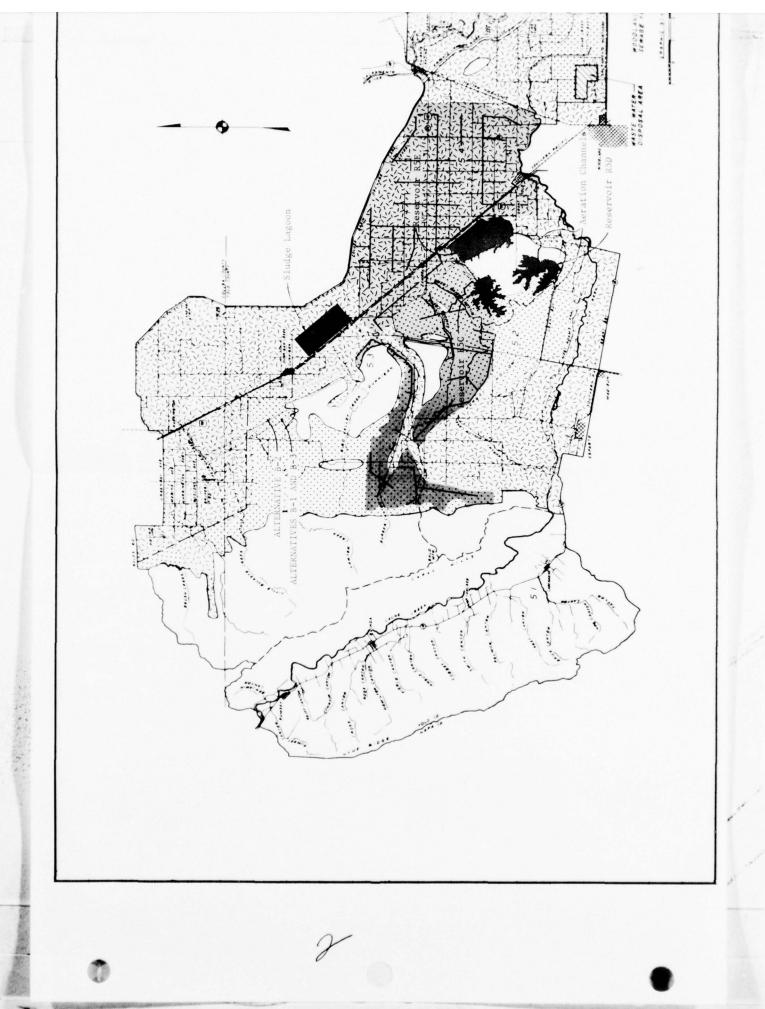
	: WASTE QU	QUANTITIES			ACRES		
					Proposed	Proposed for Use	
Land	: Wastewater : (MGD)	Sludge (dry tons/yr)	Suitable for: Wastewater: and Sludge: Application:	Wastewater	Sludge	Wastewater 1/ and Sludge Storage 2/	Total
4	15	0	3,700	3,700	0	670	4,170
5	218	170,800	192,000	076,04	34,160	6,320	81,420
18	81	12,800	53,900	16,500	2,523	1,040	20,063
21	55	15,000	45,300	11,320	3,020	1,177	15,517
27	Not Used	1	27,900	ı	ı	ı	
28	5	700	14,000	890	150	417	1,517
42	118	23,400	37,700	19,000	099,4	1,310	24,970
43	18	18,600	53,700	4,650	3,740	615	6,005
TOTAL 3/	510	241,000	458,200	92,000	78,000	11,500	156,500

Excludes reuse reservoirs.
Includes storage at offsite facilities.
Some totals rounded. निहारी

- a. Wastewater discharged to Site 4 would receive secondary treatment at the Fairfield facility and then would be pumped to an offsite storage reservoir in the Potrero Hills. Plate 11 shows the wastewater reservoir location, the main distribution pipeline, and the area to be irrigated. The only area suitable for crops within this site is north of Grizzly Slough and the wastewater, approximately 15 MGD, would be applied there. Sludge would not be applied at this site due to the limited dry land available for application. A total of 3,700 acres would be used at this landsite for wastewater application.
- b. Site 5 is located in the northeastern portion of Yolo County (including the southern tip of Colusa County) and would receive approximately 218 MGD of secondary effluent from treatment facilities in Sacramento, Yolo, and part of Solano Counties. Plate 12 shows the three onsite wastewater storage reservoirs, the one sludge lagooning area, the main distribution pipelines, and the actual areas to be irrigated. The land application areas were selected as close to the reservoirs as economically practical. The crop area north and east of the reservoirs was used since a minimum of pumping would be required for the distribution system. The pastureland north and west of the reservoirs was used since it provided the most economical distribution system and minimum land cost. A total of 75,100 acres (39 percent of the total suitable acreage) would be used at this site for the land application of wastewater and sludge.
- c. Site 18 in southwestern Sonoma and northwestern Marin Counties, would receive about 81 MGD of secondary effluent. Plate 13 shows the four proposed wastewater reservoirs, the three sludge lagoons, the main distribution pipelines, and the actual areas to be irrigated. Two of the wastewater reservoirs would be small in size because they receive the flow from small isolated communities. One reservoir and one sludge lagoon are situated east of the site. A total of 19,000 acres (35 percent of the total suitable acreage) would be used at this site for the land application of wastewater and sludge.
- d. Site 21, see Plate 14, is located in northeastern Sonoma County and would receive approximately 55 MGD of treated effluent from several locations. A total of three wastewater and three sludge lagoons would be required. One sludge lagoon is located east of the site. The wastewater disposal areas were selected as close to each reservoir as possible. For Reservoir R21B the cropland adjacent to the reservoir would be used since this would provide the most economical distribution system. The pastureland immediately north of Reservoir R21C would not have sufficient capacity for all the wastewater from that reservoir. Additional area would be required and the pasture area further north was selected. The most economical land application area for the wastewater from Reservoir R21D would be the cropland adjacent

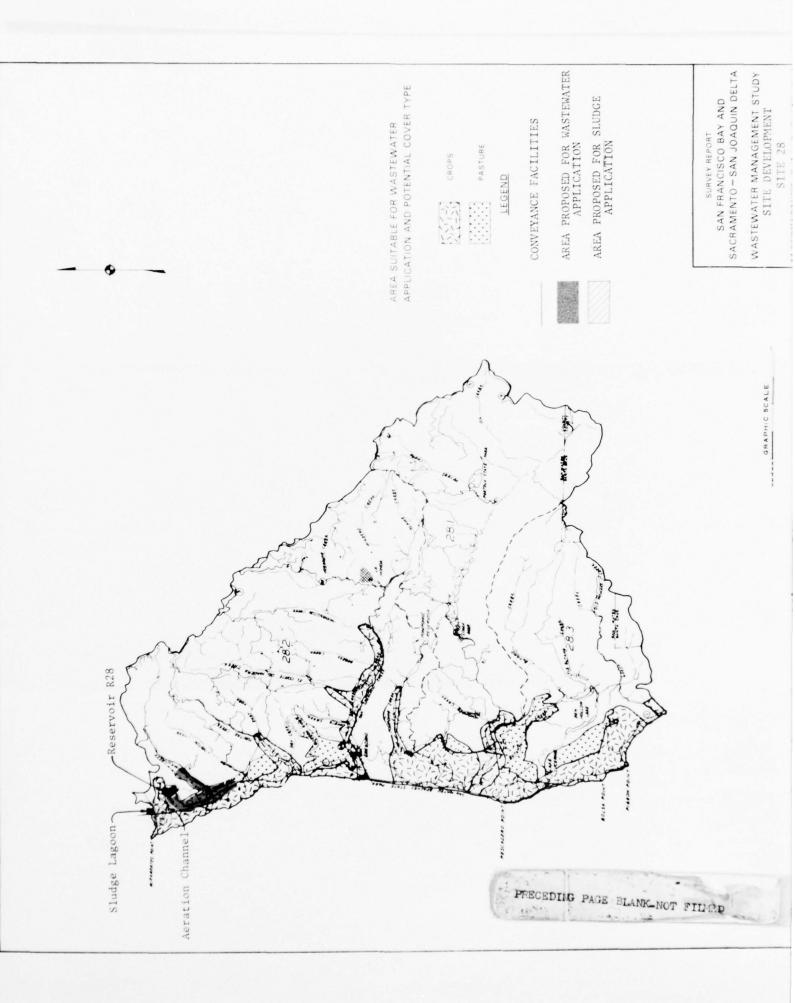


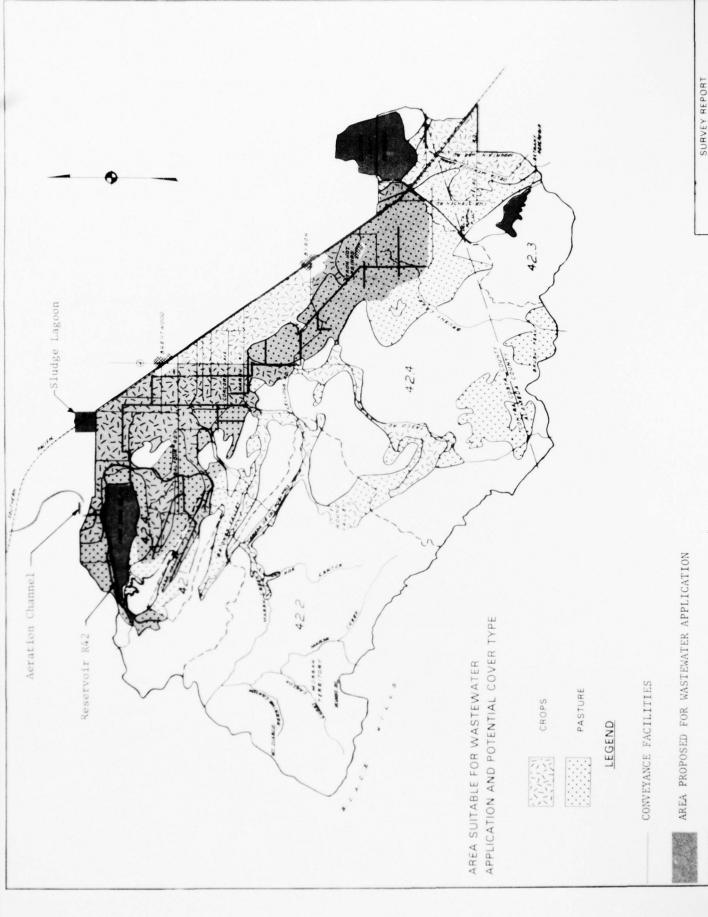




to Highway 101. A total of 14,300 acres (32 percent of the total suitable acreage) would be used at this site for the land application of wastewater and sludge.

- e. The secondary treatment plant at Half Moon Bay in San Mateo County would discharge its effluent to Site 28. The effluent, about five MGD, would be pumped to one onsite reservoir (see Plate 15) in the northwestern portion of the area. The pasture adjacent to the reservoir and east of Highway 1 was selected for wastewater disposal because it was closest to the reservoir. A total of 1,040 acres (7.5 percent of the total suitable acreage) would be used at this site for the land application of wastewater and sludge.
- f. Wastewater from the Central Contra Costa County facility would be pumped to one onsite reservoir at Site 42. Plate 16 shows site development features. The sludge lagoon lies north of the site. Since the land adjacent to the reservoir would provide for the most economical distribution system, it was the first to be selected for wastewater disposal. This area was not sufficient to dispose of the total effluent. Therefore, the pastureland south and west of Byron was selected. This land was used because it would be more economical to irrigate than the narrow valleys that extend into the hills. Also, since pastureland has a higher application rate and lower cost than does cropland, less acreage would be required. A total of 23,660 acres (63 percent of the total suitable acreage) would be used at this site for the land application of wastewater and sludge.
- g. The secondary treatment plants at Manteca and Tracy would discharge to two reservoirs located at Site 43 in San Joaquin County. Because natural reservoir areas within the site are limited, one of the wastewater reservoirs and one sludge lagoon would be located out of the site location. Plate 17 shows the reservoir locations for wastewater and sludge, disposal areas, and the main distribution pipelines for the 18 MGD of wastewater to be applied. The cropland adjacent to each of the reservoirs would be used for wastewater application. A total of 8,390 acres (16 percent of the suitable acreage) would be used at this site for the land application of wastewater and sludge.
- 173. Sludge lagoons would be located near the wastewater storage reservoirs in order to minimize maintenance crew travel time. The sludge application sites would be located in relatively flat areas that could be easily disc harrowed. In developing the site layout, the wastewater application area was located nearest the wastewater reservoir to minimize pipe and pumping costs. Since there can be no wastewater applied to an area that will receive sludge, the sludge application area was located outside the wastewater application area. This would provide a satisfactory economical arrangement since sludge application requires no fixed distribution system. Plates 11 through 17 show the sludge application areas within each land site.



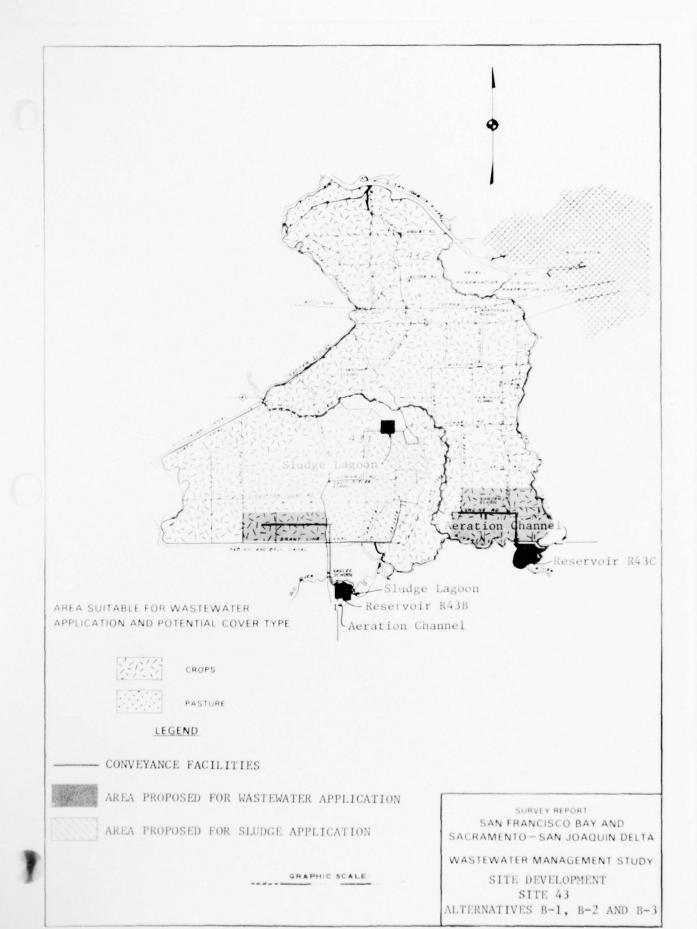


SAN FRANCISCO BAY AND
SACRAMENTO — SAN JOAQUIN DELTA
WASTEWATER MANAGEMENT STUDY
SITE DEVELOPMENT

ALTERNATIVES B-1, B-2 AND B-3

IIC SCALE:

AREA PROPOSED FOR SLUDGE APPLICATION



- 174. Sludge System S-1 (see Plate 7) would be applicable for wastewater Alternatives B-1, B-2 and B-3. Sludge from the San Mateo coastal secondary plant (SM05) would be trucked to Site 28. Sludge from Gilroy-Morgan Hill would be trucked to San Jose. A rail line terminating at the San Francisco Southeast Plant would pick up all of the sludge produced at the facilities north of San Jose. Additionally, sludge from the North San Mateo County plant would be trucked to the Lake Merced facility and the total sludge would be piped to the Southeast facility. Sludge produced along the East Bay (including Livermore Valley) would be transported by truck to San Leandro and then by rail to the Richmond facility to be joined by a rail line from San Pablo. A barge would then collect the sludge from both the Southeast and Richmond facilities and transport it to an unloading facility near Sacramento. Here the sludge would be unloaded and transported by rail line to Site 5.
- 175. A rail line would originate in Central Marin and would pick up sludge along the way, transporting it to Site 18. Sludge from small communities in Sonoma and Marin Counties would be trucked to Site 18.
- 176. Sludge from the Napa Valley would be transported by rail to Calistoga and trucked to Site 21. Smaller communities near Site 21 would truck sludge directly to the land area. Sludge from the Fairfield area would be trucked to the Napa Valley rail line originating at Vallejo.
- 177. Sludge from Central Contra Costa County would be railed and trucked to Site 42. Sludge from the facilities in San Joaquin County would be trucked to Site 43.
- 178. A rail line would transport sludge from the Sacramento area and from the barge unloading facility to Site 5. Communities in Solano, Sacramento, and Yolo Counties would truck sludge to the rail line or truck directly to Site 5.
- 179. Alternative B-2 Except for the degree of treatment that would be required for discharges to waterways, Alternative B-2 (Plate 18) is identical to Alternative B-1 (see Plate 10). Wastewater quantities are the same. A total of 945 MGD (65 percent of the year 2000 flow) would receive advanced treatment and 510 MGD (35 percent of the year 2000 flow) would be applied to the land. The criteria for the degree of treatment in this alternative was applied to all unit processes after secondary treatment so that the total emissions of individual constituents discharged to each water quality zone would not exceed the quantity discharged under the Base Condition. All discharges in each zone would be required to have identical treatment levels. Using this criteria, discharges to the Pacific Ocean, South Bay, and Central Bay would receive secondary treatment followed by dual media filtration. In the Delta, secondary treatment plus 80 percent phosphorus removal and nitrification and denitrification would be required. Wastewater constituents discharged to the various water quality zone: under this alternative are summarized in Table 21.

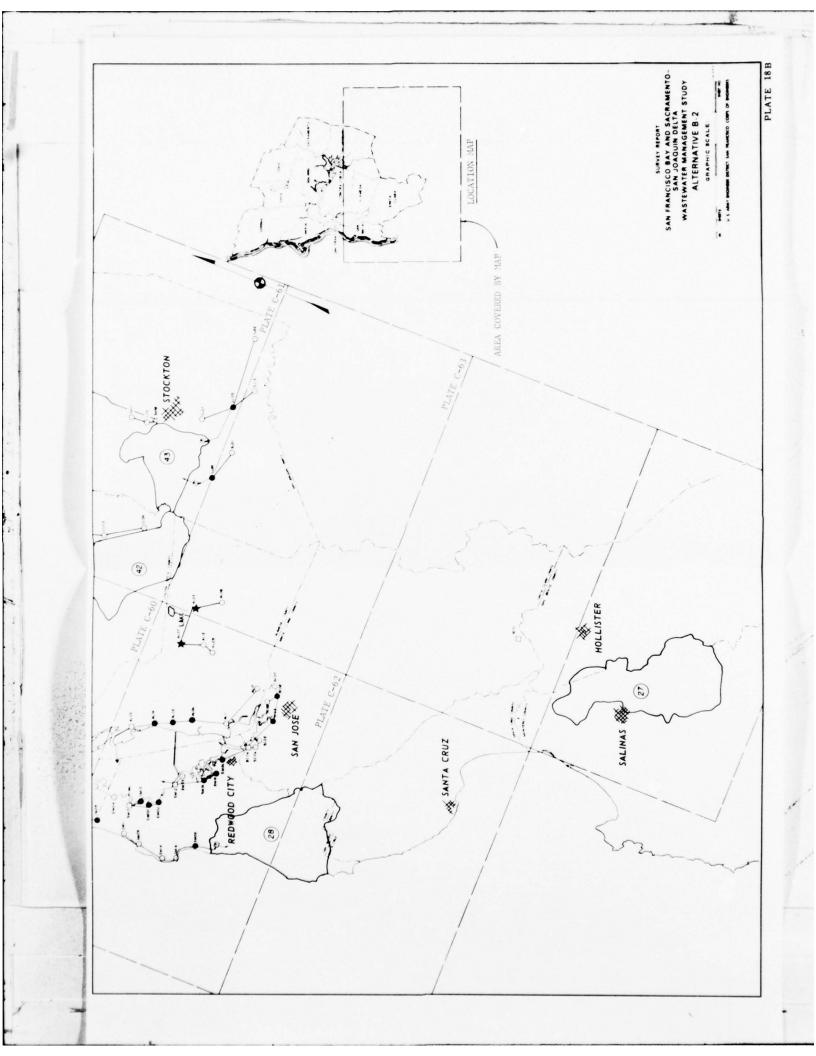


TABLE 21

WAS EMATER CONSTITUENT DISCHARGE SUMMARY

Alternative B-2

(Discharge to Surface Waters)

		Base Co	Base Condition				Alte	Alternative B-2	B-2	
LOCATION	FLOW	BOD	Z.	TP	GHM	FLOW	BOD	NI	TP	GHIM
PACIFIC OCEAN	115	57.6	57.6 13.8 3.8 1.9	3.8	1.9	129		8.1	1.3	0.8
SOUTH SF BAY	372	58.6	31.1	22.7	6.6		30.0	27.9 6.1 3.2	6.1	3.2
CENTRAL SF BAY	130	24.9 12.5 7.5 3.3	12.5	7.5	3.3	167	10.0	9.01	1.7	0.9
CARQUINEZ STRAIT - SUISUN BAY	107	16.9	10.1	6.5	2.9	0	0	0	0	0
DELTA	207	27.0	27.0 14.7 9.7 4.3	9.7	4.3	66	5.8	6.0	0.9 1.2	0.2
TOTAL	931	185.0	185.0 82.2 50.2 22.3	50.2	22.3	945	945 53.5 47.5 10.2 5.1	47.5	10.2	5.1

NOTES:

Flow reported in MGD.

Constituents reported in 1,000 lbs/day.

- 180. The sludge lagoons for this alternative would be in the same location and have the same operation and maintenance considerations as those in Alternative B-1. Also, the sludge application sites would emain the same as in Alternative B-1. The land area required for sludge lagoons and application would be reduced slightly since, because of the lower degree of treatment, smaller quantities of sludge will be produced. Plates 11 through 17 also show site development features for this alternative. Total land requirements in the vicinity of the land-sites are about 155,400 acres.
- 181. Alternative B-3 This alternative (see Plate 19) is another variation of Alternative B-1. Wastewater from San Jose, Milpitas, and Alviso would receive secondary treatment at the San Jose Plant prior to conveyance to Site 27. Secondary effluent from the Gilroy-Morgan Hill facility would also be conveyed to Site 27. Year 2000 flows for these discharges are 187 MGD. A total of 758 MGD (51 percent of the year 2000 flow) would receive tertiary treatment and 697 MGD (49 percent of the year 2000 flow) would be applied to land. Wastewater constituents discharged to the various water quality zones are summarized in Table 22.
- 182. Except for the addition of Site 27, land application areas would remain the same as in Alternative B-1. Two reservoirs would be used to store the additional 187 MGD. Capacity in Site 27 would also accommodate all of the projected flows in the Monterey, Salinas, Santa Cruz complex for the year 2000. Plate 20 shows the location of the two reservoirs (one of which is offsite), the area to be irrigated, and the main distribution pipelines. As with the other sites, the land nearest the reservoirs would be most economical to irrigate. The pastureland in the northwestern portion of the site would be used for wastewater from Reservoir R27C. The pastureland in the southeastern portion of the area would be utilized for wastewater from Reservoir R27D. However, this area would not have sufficient capacity for the total volume of effluent. Therefore, the cropland adjacent to the pasture area would be used. A total of 37,970 acres (65 percent of the total suitable acreage) would be used in Site 27 for wastewater application. Total land requirements for this alternative in the vicinity of the eight landsites are about 195,000 acres.
- 183. The sludge transportation, treatment, and application systems for this alternative would be identical to those of Alternative B-1. Even though the wastewater from San Jose and Morgan Hill-Gilroy facilities would go to Site 27, the sludge produced at these plants would still go to Site 5 as in Alternative B-1.
- 184. Alternative D-1 In this alternative (see Plate 21) wastewaters would either receive tertiary treatment and be discharged to local waterways or be conveyed from local sources to land areas where they would receive the equivalent of secondary treatment in onsite aeration lagoons prior to storage and application on the land. Base Condition treatment facilities not used in connection with disposal to water bodies would be converted to pump stations.

TABLE 22

WASTEWATER CONSTITUENT DISCHARGE SUMMARY

Alternative B-3

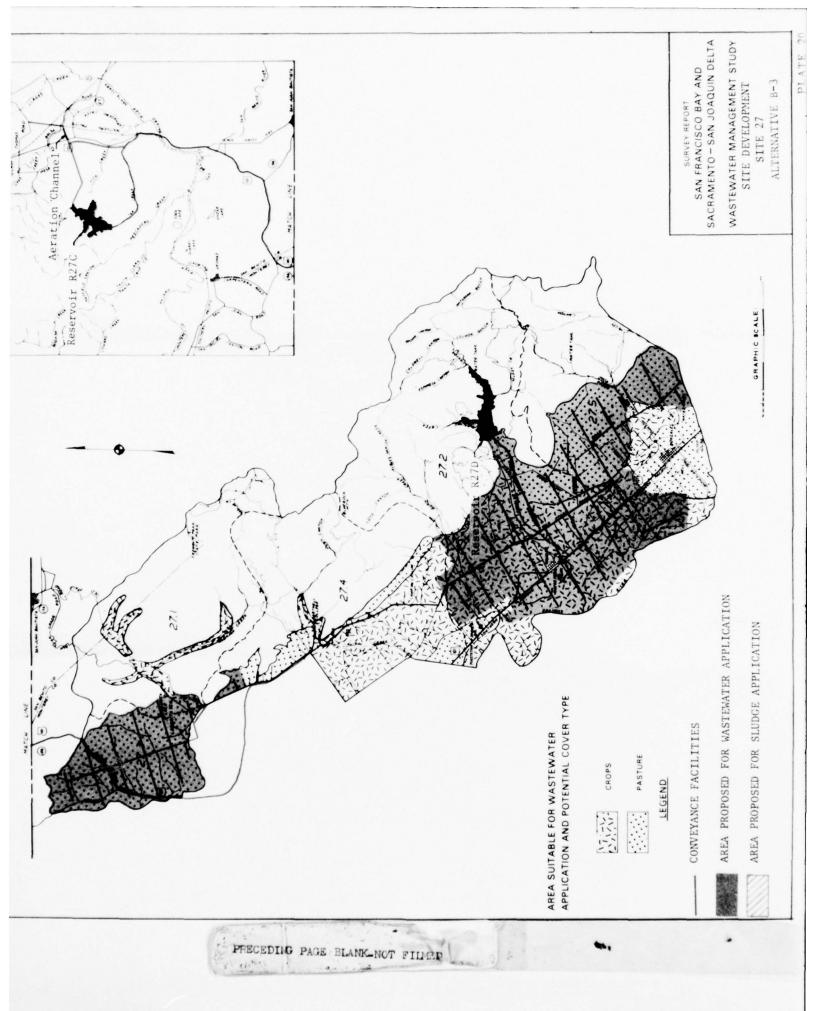
(Discharge to Surface Waters)

		Base Condition	lition				Alt	Alternative B-3	e B-3	
LOCATION	FLOW	BOD	Ę	TN TP	GHM	FLOW	BOD	BOD TIN TP	Ę	CHIM
PACIFIC OCEAN	115	57.6	13.8 3.8 1.9	3.8	1.9	120	1.9		0.6 0.1	0.5
SOUTH SF BAY	372	58.6	31.1	31.1 22.7 9.9	6.6	372	4.5	4.5 1.6 0.3	0.3	1.6
CENTRAL SF BAY	130	24.0	12.5 7.5 3.3	7.5	3.3	167	2.8	2.8 0.8 0.2	0.2	0.7
CARQUINEZ STRAIT - 107 SUISUN BAY	107	16.9 10.1 6.5 2.9	10.1	6.5	2.9	0	0	0 0 0 0	0	0
DELTA	207	27.0	27.0 14.7 9.7 4.3	6.7	4.3	66		1.5 0.5 0.1 0.4	0.1	7.0
TOTAL	931	185.0 82.2 50.2 22.3	82.2	50.2	22.3	758	758 10.7 3.5 0.7 3.2	3.5	0.7	3.2

NOTES:

Flow reported in MGD.

Constituents reported in 1,000 lbs/day.



185. As in the B-l alternative, all wastewaters in the South Bay (550 MGD) would receive tertiary treatment at five facilities and be discharged between Dumbarton Bridge and the San Francisco-Oakland Bay Bridge. Approximately 129 MGD would be discharged to the Pacific Ocean after tertiary treatment, 120 MGD from the San Francisco area, less than 1 MGD from Bolinas-Stinson Beach, 9 MGD from the Gilroy-Morgan Hill area which would reach the Pacific Ocean via Llagas Creek and the Pajaro River. These subsystems are identical to Alternative B-1.

186. A major difference between Alternatives B-l and D-l is that in D-l there would be no discharge to Central Bay and only 2 MGD discharged in the Delta from three tertiary plants at Isleton, Rio Vista, and Walnut Grove. A total of 681 MGD (47 percent of the year 2000 flow) would be discharged to water after tertiary treatment compared to 945 MGD in Alternative B-l. Wastewater constituents discharged to the various water quality zones are summarized in Table 23.

187. More wastewater would be directed to the land areas in this alternative than in Alternative B-1 (510 MGD). Site 18 would receive 81 MGD from Marin County (except the Bolinas-Stinson Beach area) and central and southern Sonoma County. Site 4 would receive 15 MGD from the Fairfield-Suisun-Travis AFB area. Site 5 would receive 218 MGD from Sacramento, Yolo, and Solano Counties. Site 28 would receive 5 MGD from San Mateo County coastal communities. All of these subsystems are identical in configuration to Alternative B-1.

188. The other land areas would be more intensely used than in Alternative B-l (although as in B-l, Site 27 would be excluded). Site 21 usage would be increased from 55 MGD in B-l to 80 MGD in D-l. The additional 25 MGD would come from the Vallejo-Mare Island-American Canyon area. Land area 21 would then handle all of the wastewater from northern Sonoma County, the entire Napa Valley and the Vallejo area. Use of Site 42 would increase from 118 MGD to 259 MGD. This comprises all of the wastewaters in Contra Costa County (with the exception of 30 MGD to be reused locally) and also includes the Benicia area. All of San Joaquín County's wastewaters (plus Elk Grove), 115 MGD, would be conveyed to Site 43 for treatment and land application. A total of 773 MGD (53 percent of the year 2000 flow) would be applied to the land under this alternative.

189. Site development details are discussed below for the land treatment of wastewater at the seven application sites. Land application data, including waste quantities and major acreage requirements by site, are shown in Table 24. Total land requirements in the vicinity of the seven landsites are about 213,200 acres.

a. Raw sewage destined for Site 4 would be pumped from the Fairfield-Travis AFB area to aeration lagoons near the Potrero Hills. The treated effluent would then be conveyed to a reservoir located adjacent to the aeration lagoons. Plate 22 shows the aeration lagoons, the storage reservoir, the main distribution pipeline, and the application area. Sludge would not be applied at this site. A total of 3,700 acres would be used at this landsite for wastewater application.

TABLE 23

WASTEWATER CONSTITUENT DISCHARGE SUMMARY

Alternative D-1

(Discharge to Surface Waters)

		Base Co	Base Condition				Altern	Alternative D-1	-1	
LOCATION	FLOW	BOD	N.	TP	GHM	FLOW	BOD	TN	TP	GHM
PACIFIC OCEAN	1115	9	13.8	3.8	1,9	129	2.1	9.0	0.1	9.0
S TH SF BAY	372	58.6	31.1	22.7	6.6	550	5.1	2.1 0.4	7.0	2.4
CENTRAL SF BAY	130	24.9	12.5	7.5	3.3	С	0	0	0	0
CARQUINEZ STRAIT - SUISUN BAY	107	16.9	10.1	6.5 2.9	2.9	0	0	0	0	0
DELTA	207	27.0	14.7	9.7 4.3	4.3	2	*	*	*	*
TOTAL	931	185.0	82.2 50.2 22.3	50.2	22,3	681	7.2	2.7	2.7 0.5 3.0	3.0

NOTES:

Flow reported in MGD.

Constituents reported in 1,000 lbs/day.

* Constituent is less than 50 lbs/day.

TABLE 24

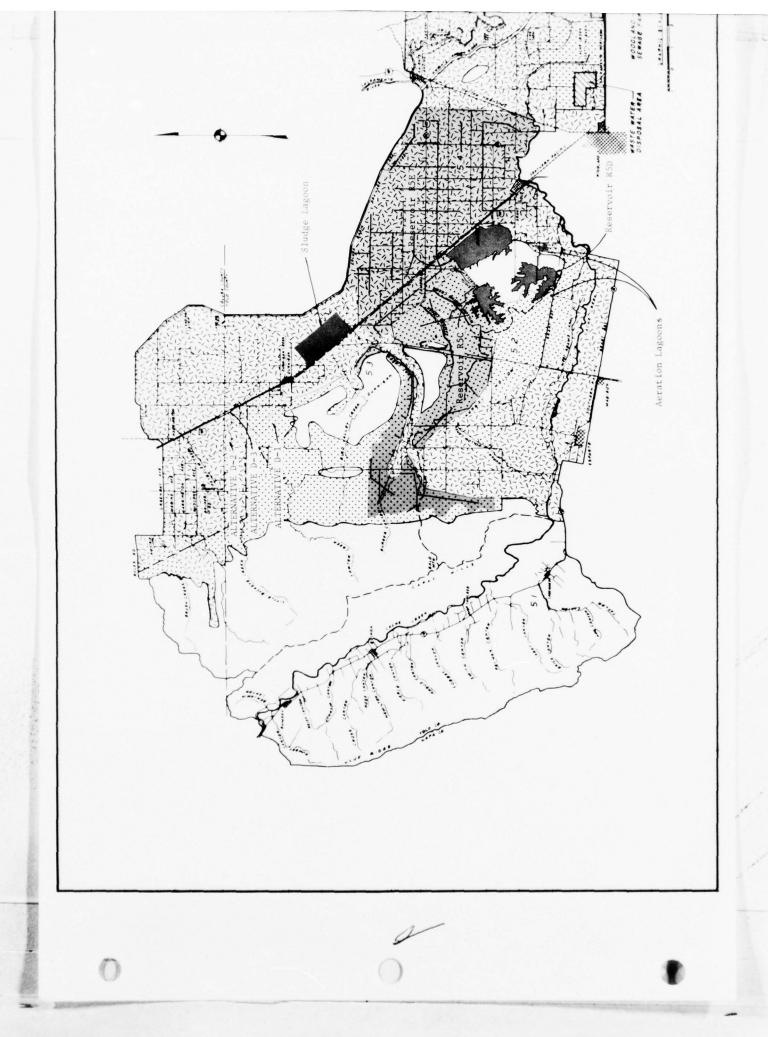
LAND APPLICATION DATA - ALTERNATIVE D-1

	: WASTE QU	QUANTITIES		ACRES	S		
				••	Proposed For Use	For Use	
			: Suitable for				
			: Wastewater	•		Wastewater 1/	/
Land	: Wastewater	Sludge	: and Sludge			and Sludge	
Site	: (MGD)	(dry tons/yr)	: Application	: Wastewater	Sludge	Storage 2/	Total
4	15	0	3,700	3,700	0	087	4,180
2	218	147,800	192,000	40,940	29,400	6,320	76,660
18	81	12,800	53,900	16,500	2,518	1,120	20,130
21	80	15,000	45,300	17,120	3,030	1,470	21,620
27	Not Used	1	57,900	1	1	1	1
28	2	800	14,000	068	150	087	1,520
42	259	45,600	37,700	25,010	9,100	4,260	38,370
43	115	18,300	53,700	44,170	3,670	3,080	50,920
TOTAL 3/	773	240,200	458,200	148,000	48,000	17,200	213,200

Excludes reuse reservoirs but includes aeration lagoons. Includes storage at offsite facilities. Some totals rounded. 3/2/1



- b. Site 5 would receive and treat in aeration lagoons approximately 218 MGD of raw sewage prior to conveyance to the three small onsite wastewater reservoirs used in Alternative B-1. Plate 23 shows the application areas for wastewater and sludge, the reservoir locations, and the main distribution pipelines as well as the location of the aeration and sludge lagoons. The wastewater and sludge application areas are generally the same as would be used in Alternative B-1. A total of 70,300 acres (37 percent of the total suitable acreage) would be used at this site for the land application of wastewater and sludge.
- c. Site 18 (see Plate 24) would receive and treat approximately 81 MGD of raw sewage in aeration lagoons. Effluent would then be conveyed to storage reservoirs. The same site development configuration used in Alternative B-1 (Plate 13) is also used under this alternative. A total of 19,000 acres (35 percent of the total suitable acreage) would be used at this site for the land application of wastewater and sludge.
- d. Site 21 would receive approximately 80 MGD of raw sewage from several locations. This is about 25 MGD more than under Alternative B-1. The raw sewage would undergo secondary treatment in aeration lagoons near the reservoir sites before being stored. Plate 25 shows the site development facilities used in this alternative. Additional crop and pasturelands north of Reservoir R21B would be required to properly apply the additional 25 MGD over Alternative B-1. A total of 20,200 acres (44 percent of the total suitable acreage) would be used at this site for the land application of wastewater and sludge.
- e. Plate 26 shows the reservoir location, application areas, the main distribution pipelines and other details for Site 28. The configuration used is the same as that in Alternative B-l except raw sewage (5 MGD) will be treated in aeration lagoons located near the reservoir. A total of 1,040 acres (7.5 percent of the total suitable acreage) would be used at this site for the land application of wastewater and sludge.
- f. Sewage from all sources in Contra Costa County except 30 MGD which would be reused locally would be pumped to Site 42. The reservoir site selected was in Lone Tree Valley. The necessary capacity would be obtained by placing a dam across the entrance of the valley and building saddle dams along the ridge around the valley. The aeration lagoons would be located just north of the reservoir to treat the expected 259 MGD (290,000 acre-feet/year) of raw sewage. Plate 27 shows the site development configuration for this site. The land proposed for sludge application would amount to 9,100 acres. This land would not be used for wastewater application. In order to utilize the remaining area to the maximum degree possible, most potential croplands would be converted to a pasture cover which allows a higher application rate. Not all croplands would be converted to pasture as this would be too disruptive on existing agricultural practices. Even with the proposed vegetative cover changes, there is not sufficient capacity within the site to take all of the flow. The remaining wastewater (68,600 acre-feet/year) would be conveyed to site 43. A total of 25,000 acres would be used at this site for the land application of wastewater.







ALTERNATIVES D-1, D-2 AND D-3

SITE 21

APPLICATION AND POTENTIAL COVER TYPE AREA SUITABLE FOR WASTEWATER



LEGEND

CONVEYANCE FACILITIES

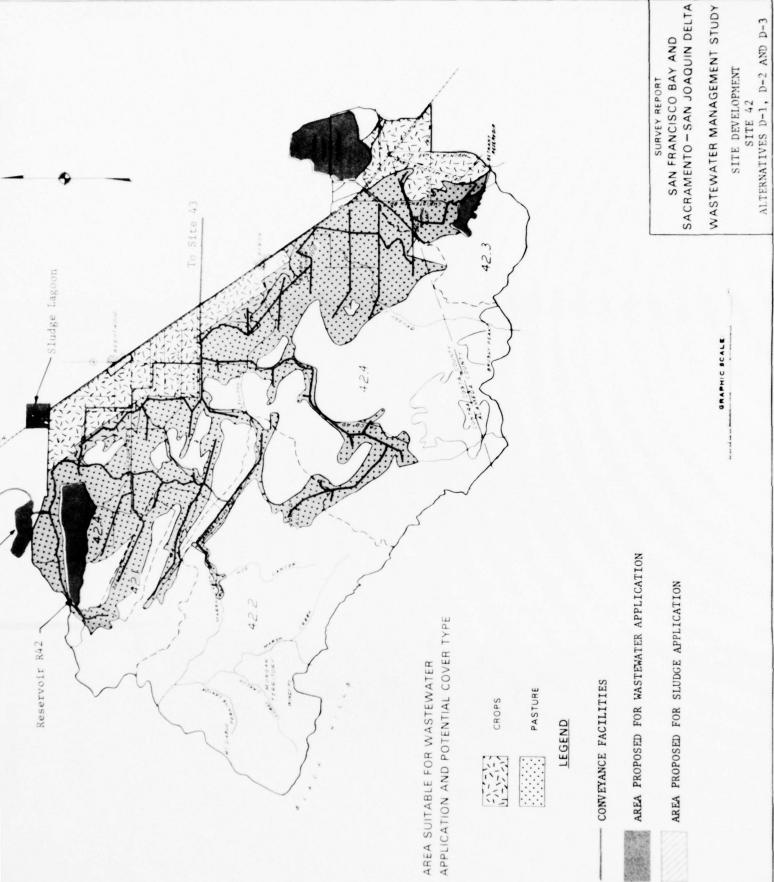
AREA PROPOSED FOR WASTEWATER APPLICATION

AREA PROPOSED FOR SLUDGE APPLICATION

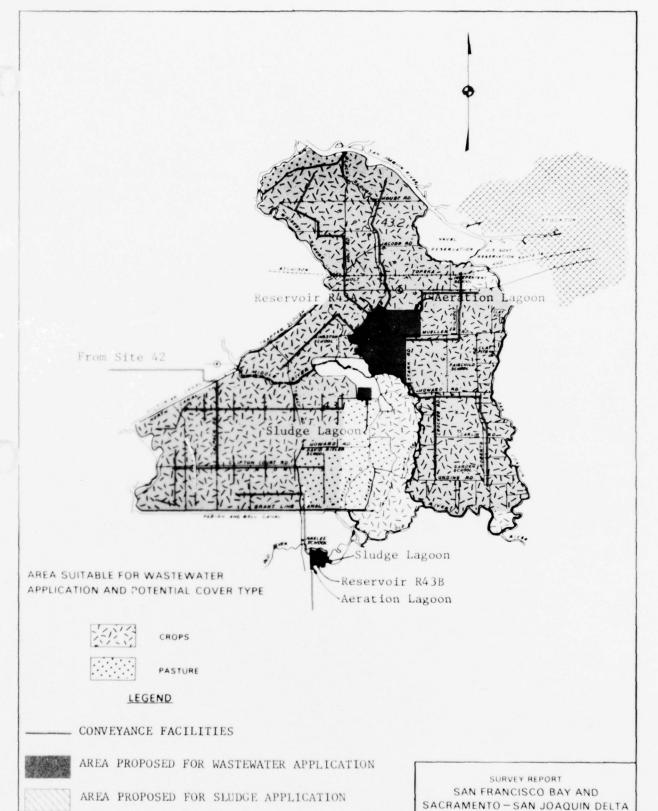
SACRAMENTO - SAN JOAQUIN DELTA WASTEWATER MANAGEMENT STUDY SITE DEVELOPMENT SURVEY REPORT SITE 28

ALTERNATIVES D-1, D-2 AND D-3

GRAPHIC SCALE



- g. Sewage, approximately 115 MGD, from San Joaquin County as well as that from Galt in Sacramento County, would be pumped to one of two aeration lagoons at Site 43. Plate 28 shows the site development configuration. The entire site would be utilized for wastewater application for the land areas in the southwestern portion of the site would be used for the wastewater pumped from Site 42. This area consists of cropland and a small portion of pastureland north of the Grant Line Canal and east of Tracy Road. A total of 47,800 acres (89 percent of the total suitable acreage) would be used at this site for the land application of wastewater and sludge.
- 190. Sludge lagoons would be located near the land treatment facilties in order to allow pumping of the digested sludge directly to the drying lagoons. Relatively flat areas are required for these lagoons to maintain the shallow depth required. The site development maps for this alternative (Plates 22 through 28) show the locations of the lagoons and application areas at each site.
- 191. Sludge System S-2 (see Plate 8) would be applicable to Alternative D-1. System S-2 is very similar to System S-1. The rail line from San Jose to San Francisco would be used for sludge generated along the west side of the bay, as well as for Gilroy-Morgan Hill sludge which would be trucked to San Jose. The East Bay concept, combining truck and rail, would terminate at Oakland. Sludge from water-oriented disposal facilities in San Mateo and San Francisco Counties would be transported to the San Francisco Southeast Plant. The barge would pick up sludge at San Francisco and Oakland and unload it near Sacramento, where it would be transported by rail and then truck to Site 5.
- 192. A Napa Valley rail line, starting at Napa and ending at Calistoga, would handle the sludge generated at Site 4. Sludge would be trucked from Site 4 to Napa and from Calistoga to Site 21. The Bolinas-Stinson Beach area would truck sludge directly to Site 18.
- 193. A truck would be used to convey sludge from the Contra Costa tertiary facility (CCO5) to Site 42. The three small tertiary plants at Rio Vista, Isleton, and Walnut Grove would truck their sludge to Site 43.
- 194. All other wastewater sources would be conveying raw wastewater to land areas for aeration lagoon treatment where sludge would be removed from the sedimentation basins, digested, stored and trucked within the sites to the proposed sludge application areas.
- 195. Alternative D-2 This alternative (see Plate 29) is a modification of Alternative D-1 using a lower degree of treatment for facilities discharging to surface water bodies. Alternative D-2 is no different than Alternative D-1 with respect to quantities of effluent conveyed to various water quality zones or land areas. A total of 681 MGD (47 percent of the year 2000 flow) would receive advanced treatment and 773 MGD (53 percent of the year 2000 flow) would be applied to the land. As in Alternative



WASTEWATER MANAGEMENT STUDY

SITE DEVELOPMENT

SITE 43 ALTERNATIVES D-1, D-2 AND D-3

GRAPHIC SCALE

PLATE 28

Delta, secondary treatment would be adequate for the three minor discharges. The wastewater constituents discharged to the various water quality zones are summarized in Table 25.

196. This alternative uses Sludge System S-2 as did Alternative D-1. The sludge lagoons for this alternative would be in the same physical location and have the same operation and maintenance considerations as those in Alternative D-1. Also, the sludge application areas would remain the same as in Alternative D-1. Smaller quantities of sludge would be produced as a result of the lower degree of treatment provided water-oriented discharges. Consequently, the land area required for sludge application would be reduced slightly. The sludge lagoon sites and application areas are shown in Plates 22 through 28. Total land requirements in the vicinity of the seven landsites are about 212,000 acres.

197. Alternative D-3 - This alternative (see Plate 30) is another variation of Alternative D-1. The wastewater from San Jose, Milpitas, and Alviso (178 MGD) would be pumped to the Gilroy-Morgan Hill area (9 MGD) were raw sewage would be treated in aeration lagoons. This wastewater would then be conveyed to Site 27. Except for the use of Site 27 (with corresponding higher waste flows to land and local sludge application) this alternative is similar to Alternative D-1. Quantities of wastewater discharged to the ocean would be reduced from 129 to 120 MGD and to South Bay from 550 MGD to 372 MGD as compared to Alternative D-1. A total of 494 MGD (34 percent of the year 2000 flow) would receive tertiary treatment and 960 MGD (66 percent of the year 2000 flow) would be applied to the land. The wastewater constituents discharged to the various water quality zones are summarized in Table 26.

198. Plate 31 shows the location of the reservoirs, the land application areas, the main distribution pipelines and other site development features for Site 27. As with the other sites, the land nearest the reservoirs would be most economical to irrigate. The same land areas would be irrigated with wastewater under this alternative as were in Alternative B-3. A total of 43,800 acres (76 percent of the total suitable acreage) would be used in this site for the land application of wastewater and sludge.

199. The sludge transportation, treatment, and application systems for this alternative would be similar to those of Alternative D-l except for the addition of Site 27. Sludge to be applied in this area would be stored in sludge lagoons located near the aeration lagoons. The sludge would be placed along Gabilan Creek and north of Camp McCallum.

200. Sludge System S-3 (see Plate 8) is for Alternative D-3 and is identical to System S-2 with two configuration exceptions. The rail line from San Jose to Sunnyvale would not be utilized and Morgan Hill-Gilrov would not truck its sludge to San Jose. Also, site quantities differ.

TABLE 25

WASTEWATER CONSTITUTENT DISCHARGE SUMMARY

Alternative D-2

(Discharge to Surface Waters)

	Base Co	Base Condition	E			Alte	Alternative D-2	D-2	
FLOW	ВОД	Z	TP	GHM	FLOW	BOD	E	TP	W III
115	57.6	13.8	3.8	1.9	129	7.7	8.1	1.3	0.8
372	9.85	31.1	2.7	6.6	550	30.0	27.9	6.1	3.2
130	24.9	12.5	7.5	3.3	0	0	0	0	0
107	16.9	10.1	6.5	6.5 2.9	0	0	0	0	0
207	27.0	14.7	9.7	4.3	2	0.3	0.2	0.1	*
931	185.0 82.2 50.2 22.3	82.2	50.2	22.3	681	38.0	38.0 36.2 7.5	7.5	4.0

NOTES:

Flow reported in MCD.

Constituents reported in 1,000 lbs/day.

* Constituent is less than 50 lbs/day.

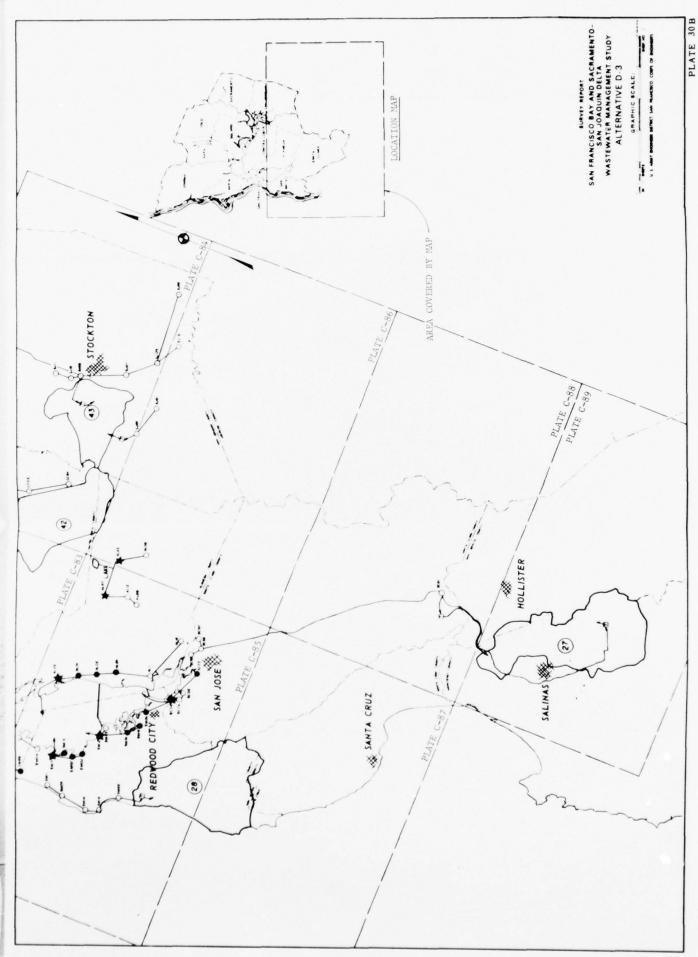


TABLE 26

WASTEWATER CONSTITUENT DISCHARGE SUMMARY

Alternative D-3

(Discharge to Surface Waters)

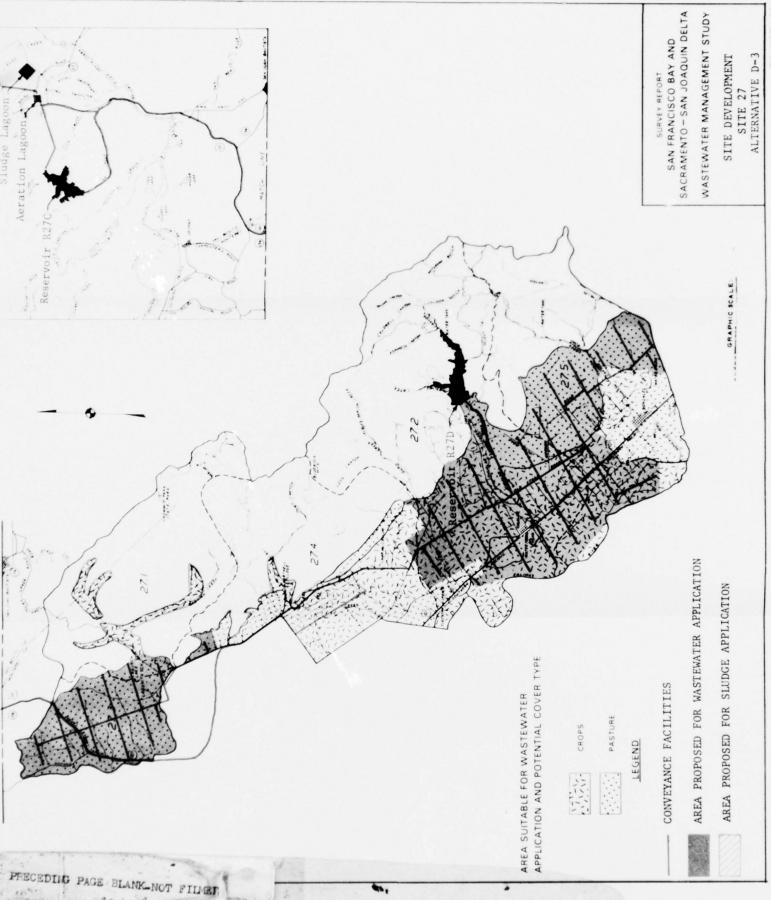
		Base Co	Base Condition				Alte	Alternative D-3	D-3	
LOCATION	FLOW	BOD	N.	TP	GHM	FLOW	BOD	Z.	TP	CHM
PACIFIC OCEAN	115	57.6	13.8	13.8 3.8 1.9	1.9	120	1.9	9.0	0.1	0.1 0.5
SOUTH SF BAV	372	58.6	31.1	22.7 9.9	6.6	372	4.5	1.6	0.3	1.6
CENTRAL SF BAY	130	24.9	12.5	7.5 3.3	3.3	0	0	0	0	0
CARQUINEZ STRAIT - SUISUN BAY	107	16.9	10.1	10.1 6.5 2.9	2.9	0	0	С	0	0
DELTA	207	27.0	14.7	9.7 4.3	4.3	2	*	*	*	*
TOTAL	931	185.0	82.2	82.2 50.2 22.3	22.3	767	4.9	2.2	7.0	0.4 2.1

NOTES:

Flow reported in MCD.

Constituents reported in 1,000 lbs/day.

* Constituent is less than 50 lbs/day.



These changes are due to the D-3 alternative in which the raw waste-waters from San Jose and Morgan Hill-Gilroy are conveyed to Site 27 for treatment and land application.

- 201. Tertiary Treatment System This system (see Plate 32) uses a full tertiary- level treatment for all discharges. It was developed chiefly to provide a cost comparison to the other systems and to depict how the sludge from such a system could be ultimately disposed of by land application. In the South Bay, 550 MGD would be discharged from 6 tertiary facilities. Approximately 165 MGD (from 12 facilities) would be discharged to the ocean. This includes San Francisco, the San Mateo Coastal communities, Bolinas-Stinson Beach-Inverness the inland discharges in Sonoma County in the Russian River Basin, and the Morgan Hill-Gilroy area which discharges to the ocean via the Pajaro River. Central Bay would receive 271 MGD (from 5 facilities) from Treasure Island, western Contra Costa County, northern Marin and southern Sonoma Counties, central Marin County and Napa Valley. About 147 MGD would be discharged into Carquinez Strait from central and eastern Contra Costa County and from most of Solano County. Additionally two discharges, Esparto and Winters, were summed in this zone. There would be 7 discharges to the Delta totalling 321 MGD; Woodland, Sacramento Region, Stockton area, southern San Joaquin County, and the three small discharges at Rio Vista, Isleton and Walnut Grove. Local reuse facilities in Livermore Valley and Contra Costa County account for 42 MGD.
- 202. Under this system, no land sites would be required for the application of wastewater. The wastewater constituents discharged to the various water quality zones are summarized in Table 27. This system uses a total of 47,000 acres (10 percent of the total suitable land) for the land application of sludge at five sites.
- 203. All sludge produced at the tertiary treatment facilities would be transported to land application sites for final disposal. Land application sites used would contain sludge lagoons and an application area for the disposal of the sludge. The use of each site with this system is as follows:
 - a. Site 4 Not used.
- b. Site 5 About 40,000 acres would be used in the same general area that sludge was applied in the B-Series and D-Series alternatives.
- c. Site 18 Only a small portion of the suitable land would be utilized; about 2,600 acres along Americano Creek in the northern portion of the land site.
- d. Site 21 Only a small portion of land (150 acres) in the southwestern portion of the land site would be used.
 - e. Site 27 Not used.

TABLE 27

WASTEWATER CONSTITUENT DISCHARGE SUMMARY Tertiary Treatment System (Discharge to Surface Waters)

		Base C	Base Condition	u			Tertiary	Tertiary Treament System	t Syster	-
LOCATION	FLOW BOD		TN TP GHM	TP	GHM	FLOW	BOD	Z.	Ë	GHM
PACIFIC OCEAN	115	57.6	13.8	3.8	1.9	165	165 2.7 0.8	8.0	0.1	0.7
SOUTH SF BAY	372	372 58.6 31.1 22.7 9.9	31.1	22.7	6.6	550	9.1	2.6	0.5 2.4	2.4
CENTRAL SF BAY	130	54.9	12.5	7.5	3.3	271	271 4.5 1.3	1.3	0.2	1.2
CARQUINEZ STRAIT - SUISUN BAY	107	16.9	10.1	6.5	2.9	147	147 2.9 0.9	6.0	0.2	0.8
DELTA	207	207 27.0 14.7 9.7 4.3	14.7	9.7	4.3	321	321 5.3 1.6	1.6	0.3 1.4	1.4
TOTAL	931	931 185.0 82.0 50.2 22.3	82.0	50.2	22.3	1,454	1,454 24.5 7.2	7.2	1.3 6.5	6.5

NOTES:

Flow reported in MGD.

Constituents reported in 1,000 lbs/day.

- f. Site 28 Only a small portion of the land near Niramontes Point would be required.
 - g. Site 42 Not used.
- h. Site 43 Sludge would be applied to 3,600 acres in the south central portion of Union Island which consists mainly of pastureland.
- 204. Detailed development schemes to be used for these landsites are shown on Plates C-98 through C-102 in Appendix C.
- 205. Sludge System S-4 (see Plate 9) was developed for the tertiary treatment system. Sludge from the Half Moon Bay facility in San Mateo County would be trucked to Site 28. The rail line from San Jose to San Francisco would be used for the west side Bay dischargers. Morgan Hill-Gilroy would truck sludge to San Jose. Livermore Valley would truck its sludge to San Leandro where a rail line would start, terminating at Richmond, picking up sludge from Oakland. Sludge from Vallejo, Central Contra Costa County, and Benicia would be trucked to a rail line along the north Contra Costa shore, also terminating at Richmond. North San Mateo County would truck its sludge to San Francisco and the Lake Merced facility would pipe its sludge to the barge facility at the Southeast Plant. A barge system would transport sludge from San Francisco and Richmond to the Sacramento unloading facility where it would go to Site 5 by pipeline. A rail line in Marin County would pick up sludge from Hamilton Air Force Base and terminate at Sebastopol where the sludge would be trucked into Site 18. Sludge from small communities in Marin and Sonoma would be trucked directly to Sites 18 and 21. Sludge from the two San Joaquin facilities and the three small dischargers at Rio Vista. Isleton, and Walnut Grove would be trucked to Site 43. Sluage generated at the facilities in Yolo and Sacramento Counties would be trucked or railed into Site 5.

JASTEWATER RECLAMATION OPPORTUNITIES

Introduction

206. In the living filter concept, secondary treated wastewaters would be applied to land areas as irrigation water. This, in itself, constitutes a reuse of wastewaters. During the initial wastewater application phase, all the water that percolates below the vegetative root zone will reach the groundwater table. Additional reuse potential also exists since some of the applied water would be recollected in underdrain systems and would be available for additional reuse once the groundwater table has been built up. It should be noted, however, that basically only the cropped land areas would be underdrained and, except for certain portions of Sites 42 and 43 in the D-Series of alternatives, pasture areas would not be underdrained. Cropped lands are generally flat and can be easily underdrained. Pasturelands are generally relying terrain which cannot be underdrained without excessive cost.

- 207. As previously stated, the water collected in underdrains would be available for further reuse opportunities. The word "further" should be emphasized since the treated wastewaters have already undergone one reuse as irrigation water on the land areas. At the same time water is being used by the plants, constituents are being removed by the soil-plant system. In this sense the living filter is a unique treatment unit since wastewater is being renovated at the same time it is being reused. Table 28 shows the quantities of water expected to be recollected in the underdrains for reuse at the year 2000 level of development. These quantities are based on the assumptions that the groundwater table has been built up to the level of the underdrains and that the underdrains are 90 percent efficient. Recollected waters would be available for a variety of beneficial purposes such as flow augmentation, agricultural irrigation, recreational lakes, industrial cooling, and groundwater recharge as shown on the sketch on page 123.
- 208. Recollected water could be used not only to meet future local deficiencies but could also serve as a local substitute water source (for example, irrigation) allowing localities either to decrease their requirements for present supplies or use existing water supplies for other purposes.
- 209. By the year 2000 other potential opportunities, not considered in detail today, could become desirable. An example of this is the current interest in artificial recreational lakes created from reclaimed wastewater. Thirty years ago the demand for this reuse opportunity was virtually non-existent. Similarly, in twenty or thirty years time the demand for water supplies could easily encompass concepts totally unknown to planners today.

Quality Considerations

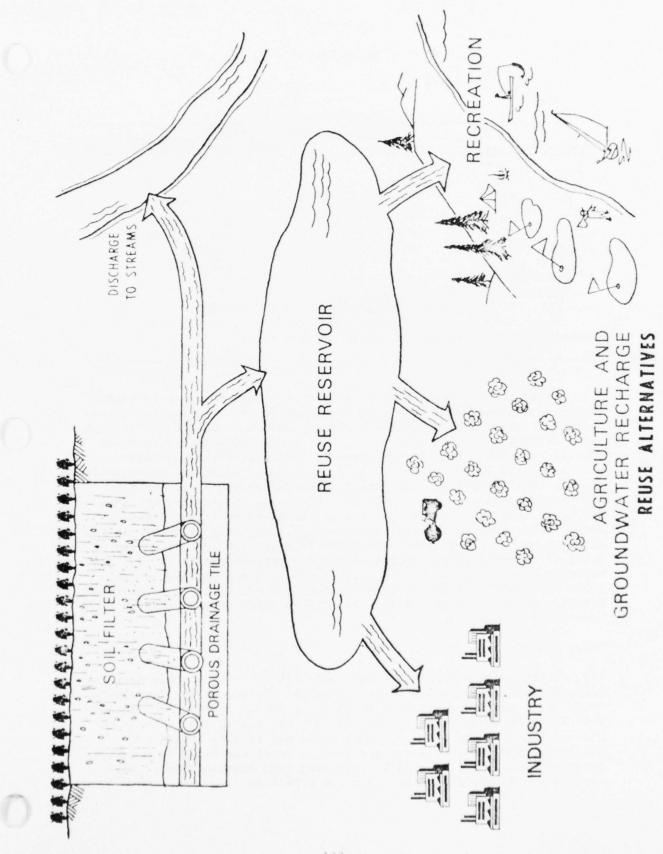
- 210. Quality considerations at the landsites for both applied wastewater and water percolating below the root zone are shown in Table 29. Quality levels for applied wastewater represent an average of aerated lagoon and activated sludge effluents with additional constituent removal as a result of storage in the wastewater holding reservoirs.
- 211. Secondary-level wastewater effluent applied to crop and pasture-lands would be satisfactory for normal irrigation purposes except for use on truck crops which could be eaten raw. As discussed later, additional measures are available (at additional cost) to avoid this exception.

TABLE 28

EXPECTED VOLUME OF RECOLLECTED WATER AVAILABLE FOR REUSE

YEAR 2000 - ACRE-FEET PER YEAR

	:							
Land	:			Altern	ative			_
Area	:	B-1	B-2	B-3	D-1	D-2	D-3	
4		8,000	8,000	8,000	8,000	8,000	8,000	
5		69,000	69,000	69,000	69,000	69,000	69,000	
18		9,700	9,700	9,700	9,700	9,700	9,700	
21		6,900	6,900	6,900	16,500	16,500	16,500	
27		0	0	19,700	0	0	19,700	
28		0	0	0	0	0	0	
42		22,200	22,200	22,200	37,300	37,300	37,300	
43		10,000	10,000	10,000	91,300	91,300	91,300	
TOTAL		125,800	125,800	145,500	231,800	231,800	251,500	



	: Quality	of Water (mg/1)
Parameter	: Applied	: Percolating Below Root Zone
BOD	20	1 - 2
TSS	20	1 - 2
TN	17	1 - 9*
TP	8	0.1 - 0.2
TDS	550	600 - 1,100
GHM	1	<0.01
BORON	0.3 - 1.0	0.2 - 0.7
BACTERIO-		
LOGICAL	Depends on Crop Type and Disinfection	NONE

^{*}Essentially all nitrogen is in the nitrate form.

212. Water percolating below the root zone should be of satisfactory quality for groundwater recharge, flow augmentation, agriculture, recreational lakes, and industrial cooling. System design indicates that percolating waters will meet public health standards with respect to nitrate nitrogen. For cropped areas it is expected that nitrogen will be in the 1-3~mg/1~range. In pasture areas nitrogen concentrations of less than 10 mg/1 are expected. These values are based on crops and pasture grasses removing 150 and 200 pounds of nitrogen per acre per year, respectively. Except for nitrogen and salinity, there is little difference in the quality of percolating water at cropped sites compared with pasture sites. Salinity is site dependent, governed by local differences in precipitation and evapotranspiration races. The salinity of percolating waters is expected to range between 600 and 1,100 mg/1 (600 to 1,100 at cropped sites and 800 to 1,100 at pastured sites). Waters of this quality are still usable for a variety of beneficial purposes.

Reuse Alternatives

213. Fifty reuse alternatives were selected for initial consideration. Table 30 shows these reuse alternatives and the quantity of reclaimed water which would be available by the year 2000. It should be noted that Reuse Alternatives 2, 8, 17, 25, 37, 41, and 43 (which envision flow augmentation to local streams) would not require additional facilities since wastewater could flow to local waterways by gravity. Reuse Alternatives 1, 45 and 47 involving flow augmentation at land after 4 and 43 would require pumps and pipelines.

TABLE 30
WASTEWATER MANAGEMENT REUSE ALTERNATIVES

Reuse Alt.	Land Site		Recollection Quantity-Year 2000
No.	& Alt.1/	Description of Reuse Alternative	Acre Feet/Year
1 *	4BD	Flow Augmentation to Suisun Marsh	8,000
2 *	5BD	Flow Augmentation to Sacramento River	69,000
3	5BD	Flow Augmentation to Sacramento River	69,000
4	5 BD	Flow Augmentation to Suisun Marsh	69,000
5	5BD	Flow Augmentation to Suisun Marsh	69,000
6 *	5BD	Industrial Cooling at Site 5	69,000
7 *	5 BD	Irrigation - Northern Portion of Area	5 69,000
8 *	18BD	Flow Augmentation to Local Stream	9,700
9 *	18BD	Flow Augmentation to Petaluma River	9,700
10	18BD	Flow Augmentation to Petaluma River	9,700
11	18BD	Irrigation in Petaluma Valley	9,700
12	18BD	Irrigation in Sonoma Valley	9,700
13	18BD	Irrigation in Northern Marin	9,700
14	18BD	Recreation at Chileno Lake	9,700
15	18BD	Recreation at Tolay Lake	9,700
16 *	18BD	Recreation at Chileno Lake	9,700
17 *	21B	Flow Augmentation to Local Stream	6,900
18 *	21B	Flow Augmentation to Napa River	6,900
19	21B	Flow Augmentation to Napa River	6,900
20	21B	Irrigation in Petaluma Valley	6,900

TABLE 30 (Cont'd)

Reuse Alt. No.	Land Site & Alt.1/	Description of Reuse Alternative	Recollection Quantity-Year 2000 Acre Feet/Year
21	21B	Irrigation in Sonoma Valley	6,900
22	21B	Irrigation in Southern Napa Valley	6,900
23	21B	Recreation at Chileno Lake	6,900
24	21B	Recreation at Tolay Lake	6,900
25 *	21D	Flow Augmentation to Local Stream	16,500
26 *	21D	Flow Augmentation to Napa River	16,500
27	21D	Flow Augmentation to Napa River	16,500
28	21D	Irrigation in Petaluma Valley	16,500
29	21D	Irrigation in Sonoma Valley	16,500
30	21D	Irrigation in Southern Napa Valley	16,500
31	21D	Recreation at Chileno Lake	16,500
32	21D	Recreation at Tolay Lake	16,500
33 *	18 & 21B	Irrigation in Petaluma Valley	16,600
34	18 & 21B	Recreation at Chileno Lake	16,600
35 *	18 & 21D	Irrigation in Petaluma Valley	26,200
36	18 & 21D	Recreation at Chileno Lake	26,200
37 *	27	Flow Augmentation to Local Stream	19,700
38	27	Flow Augmentation to Salinas River	19,700
39 *	27	Irrigation at Castroville	19,700
40 *	27	Groundwater Recharge - Eastside Area	19,700
41 *	42B	Flow Augmentation to Local Stream	22,200

TABLE 30 (Cont'd)

Reuse Alt. No.	Land Site & Alt.1/	Description of Reuse Alternative	Recollection Quantity-Year 2000 Acre Feet/Year
42 *	42B	Industrial Cooling at Antioch	22,200
43 *	42D	Flow Augmentation to Local Stream	37,300
44 *	42D	Industrial Cooling at Antioch	37,300
45 *	43B	Flow Augmentation to Local Stream	10,000
46	43B	Industrial Cooling at Antioch	10,000
47 *	43D	Flow Augmentation to Local Stream	91,300
48 *	43D	Industrial Cooling at Antioch	91,300
49 *	42 & 43B	Industrial Cooling at Antioch	32,200
50 *	42 & 43D	Industrial Cooling at Antioch	128,600

^{1/ &}quot;B" refers to Alternatives B-1, B-2, and B-3.
"D" refers to Alternatives D-1, D-2, and D-3
except for Area 27 which is in Alternative B-3
and D-3 only.

^{*} Selected for additional study.

- 214. Following preliminary screening, twenty-five of the reuse alternatives (as indicated on Table 30) were selected for further study. Those twenty-five reuse alternatives selected for additional study are delineated on Plate 33 and are described as follows:
- a. Reuse Alternative 1 This alternative involves collecting the water from the subdrains at Site 4 and pumping it into Suisun Marsh for flow augmentation.
- b. Reuse Alternatives 2, 8, 17, 25, 37, 41, and 43 These alternatives involve flow augmentation to local streams and therefore have no additional pumps or pipelines. Since no new facilities are required, no additional cost is involved.
- c. Reuse Alternatives 6 and 7 In these alternatives the recollected water from Site 5 would be pumped to a reservoir on Bird Creek. In Alternative 6, water from the reservoir would be used for future industrial cooling near the site. In Alternative 7, water would be pumped to the northern portion of Site 5 and would be used for irrigation.
- d. Reuse Alternative 9 In this alternative the reclaimed water would be collected at two points near the croplands in Site 18. From these points it would be pumped to the headwaters of tributaries to the Petaluma River for flow augmentation.
- e. Reuse Alternative 16 The recollected water from the southern portion of Site 18 would be collected and pumped to Chileno Lake. This reservoir site was proposed as a recreational lake created from reclaimed wastewater in the 1972 North Marin South Sonoma Subregional Water Quality Management program. The dam proposed in that report would be raised to provide the capacity for additional water. This would provide for a larger surface area and hence greater recreational benefits.
- f. Reuse Alternative 18 This alternative collects and conveys recollected water from the southern crop area in Site 21 for the B-series of wastewater alternatives. This water would be collected and pumped to the headwaters of the Napa River for flow augmentation.
- g. Reuse Alternative 27 This alternative is similar to Alternative 18. The difference is that this alternative applies to the D-series of wastewater alternatives. The D-series alternatives envisions that an additional area of cropland in the central portion of Site 21 would be irrigated and therefore underdrained. This water would be collected and pumped to the southern crop area and the combined flow would then be pumped to the headwaters of the Napa River for flow augmentation.

PLATE 33 A

- h. Reuse Alternatives 33 and 35 Reuse Alternative 33 applies to the B-series of wastewater alternatives and Reuse Alternative 35 applies to the D-series of wastewater alternatives. Reclaimed water would be collected in Sites 18 and 21 as in the previous alternatives. From Site 21, this water would be pumped to the northern collection point in Site 18. The combined flow would continue from this point to Chileno Lake. The recollected water from the southern portion of Site 18 would be pumped directly to Chileno Lake where it would be available for an irrigation supply for Petaluma Valley.
- i. Reuse Alternatives 39 and 40 In these alternatives, water would be recollected from the irrigated area west of Highway 101 in Site 27. In the remaining irrigated crop area, underdrains would not be effective. In Alternative 39 water would be collected by gravity and pumped to a regulating reservoir east of Castroville. During the irrigation season, water would be pumped from the reservoir to the vicinity of Castroville for irrigation. In Alternative 40, the water would be collected as in the previous alternative. From the collection point it would be pumped to a groundwater recharge reservoir on Quail Creek. This reservoir would be located above elevation 180, where the percolation rate has been estimated at approximately 2.5 feet per day.
- j. Reuse Alternatives 42 and 44 Alternative 42 applies to the B-series of wastewater alternatives and Alternative 44 applies to the D-series of wastewater alternatives in Site 42. Reclaimed water would be collected by gravity and pumped to a regulating reservoir south of Antioch. During the summer when salinity intrusion makes the river water unsuitable for cooling, water from the reservoir could be used.
- k. Reuse Alternatives 45 and 47 These reuse alternatives would supply additional outflow to the Sacramento-San Joaquin Delta. Alternative 45 applies to the B-series of wastewater alternatives and Alternative 47 applies to the D-series for Site 43. Water in these alternatives would be collected by gravity and pumped over the levee surrounding the area into the Delta.
- 1. Reuse Alternative 48 In this alternative, water would be recollected by gravity from Site 43 for the D-series of wastewater alternatives. This water would then be pumped to reservoirs south of Antioch. Two reservoirs would be required since no single site could be located with sufficient capacity for the total volume. The water from these reservoirs would be used for industrial cooling as described in Alternatives 42 and 44.
- m. Reuse Alternative 49 In this alternative, reclaimed water from Sites 42 and 43 would be collected and pumped to a regulating reservoir. This reuse alternative applies to the B-series of wastewater alternatives. The water from Site 43 would be collected by gravity and pumped to Site 42 where it would join the flow from that area. The combined flow would then be pumped

to a reservoir south of Antioch. Water from this reservoir would be used for industrial cooling as described in Alternatives 42 and 44.

- n. Reuse Alternative 50 This alternative combines reuse Alternatives 44 and 48. In this alternative, the combined flow of recollected water from Sites 42 and 43 would be pumped to storage reservoirs. As in Alternative 48, two reservoirs would be required since no single site of sufficient capacity could be located. The water from these reservoirs would be used for industrial cooling as described in Alternatives 42 and 44.
- 215. Except at Sites 4 and 43 no additional costs are envisioned for the flow augmentation reuse alternatives. Costs for flow augmentation reuse at Sites 4 and 43 have been included in the costs of the wastewater management alternatives. Use of the other alternatives would require regulation reservoirs since the demand is not constant but occurs only during a few months. Conveyance facilities would also be required to convey the water from the land application sites to the reservoirs or the reuse areas. Estimated costs associated with implementing the remainder of the 25 selected reuse alternatives are discussed later under economic considerations.

Croundwater Replenishment

216. So far, reuse opportunities associated with the applied wastewaters and the recollected waters have been discussed. Limited reuse opportunities can be associated with that portion of the applied waters which percolates directly to groundwater from the non-underdrained pastured areas. Table 31 shows these quantities for the year 2000 level or development. Quality of water percolating below the root zone has previously been discussed. Except for total nitrogen and salinity, quality of this water is the same as that recollected in underdrains.

MONITORING PROGRAMS

Introduction

217. A necessary requirement for any wastewater management system is the development and implementation of a monitoring program to measure the effectiveness of the plan. A monitoring system normally consists of three parts: collection of samples; analysis of the samples; and reporting, storage and retrieval of the resulting data. If an electronic data processing system is employed to store the information, it is possible to program the production of standard reports for the easy retrieval of data.

Monitoring Requirements

218. Objectives of the monitoring program determine the type of tests to be taken, frequency of testing, location of test sites, and requirements for laboratory facilities. Such a monitoring program would be operated by the wastewater management agency which

QUANTITIES OF WATER PERCOLATING
DIRECTLY TO GROUNDWATER FROM PASTURED AREAS
(AFY)

Area			Altern	ative		
	В1	B2	В3	D1	D2	D3
4	0	0	0	0	0	0
5	85,370	85,370	85,370	85,370	85,370	85,370
18	53,180	53,180	53,180	53,180	53,180	53,180
21	38,870	38,870	38,870	53,070	53,070	53,070
27	0	0	90,900	0	0	90,900
28	3,740	3,740	3,740	3,740	3,740	3,740
42	61,400	61,400	61,400	104,700	104,700	104,700
43	1,120	1,120	1,120	10,120	10,120	10,120
Total	243,680	243,680	334,580	310,180	310,180	401,080

would normally be responsible for the complete and proper operation of the wastewater management system. Any wastewater management monitoring program must:

- a. Determine the qualitative and quantitative effects of the implementation of a wastewater management alternative on surface and groundwaters, soil structure, and vegetation;
- b. Detect, identify, and determine the source of any condition which could degrade the quality of surface and groundwaters; and.
- $\ensuremath{\text{c.}}$ Provide an environmental evaluation of the wastewater system.
- 219. In order to insure that these objectives have been met, a monitoring program for land application of wastewater would consist of: (a) a monitoring network; (b) laboratory support for the quantitative analysis of the samples; and, (c) data evaluation, storage, and retrieval. The monitoring network would consist of permanent sampling points established in all the landsites, including stations for monitoring land quality, ecological conditions, recollected water quality, and possible groundwater degradation. Several stations would be located in each land area where wastewater and sludge are applied. In addition to normal sewage treatment plant tests, the following parameters would be tested:
- a. Groundwater total nitrogen, nitrate nitrogen, total dissolved solids, heavy metals, total phosphorus and pathogenic organisms;
- b. Recollected water total dissolved solids, total nitrogen, nitrate nitrogen, total phosphorus, heavy metals and pathogenic organisms;
 - c. Soil heavy metals and total nitrogen at various depths;
 - d. Vegetation heavy metals and total nitrogen;
 - e. Air odors and aerosol emissions;
- f. Wildlife possible vectors such as mosquitoes, flies, and rodents; and,
- g. Surface runoff (during the winter when the spray application of wastewater is halted) heavy metals, total nitrogen, total phosphorus and pathogenic organisms.

ECONOMIC CONSIDERATIONS AND DESIGN FLEXIBILITY

ENGINEERING ECONOMIC ASSUMPTIONS

- 220. The following factors and assumptions were used in developing the first and annual costs used in this study:
- a. Design Life The design life of pumping stations and treatment facilities, including land disposal systems, was assumed to be 30 years. The design life of conveyance lines was assumed to be 50 years.
- b. Project Life The project life was assumed to be 50 years and all capital costs were amortized over this period in order to compute annual costs.
- c. Replacement of Facilities Replacement costs for facilities which are to be replaced at specific intervals (10, 25, and 30 years) were all put on a present worth basis by discounting at the appropriate interest rate.
- d. Salvage Value No salvage value was assumed for treatment facilities and pumping stations.
- e. Use Contract It was assumed that the landowner would be paid 25 percent of the lease cost for the use of the land. Average compensation to the landowner would be about \$40 per acre per year. This would be in addition to all agricultural profits the landowner would normally make.

COST DETERMINATIONS

- 221. Detailed cost estimates were made for each wastewater management alternative based on two concepts of two land acquisition and system operations. Monitoring program costs have not been included. Under the first concept, all land required would be purchased directly in fee: system-required lands would be owned and operated by a wastewater management agency. Under the second concept and the one evaluated in this report, use contracts would be established between the wastewater management agency and the landowners. Under the use contract concept, the following assumptions were made:
- a. All land required for treatment facilities, pumping stations, storage reservoirs, and reuse reservoirs would be purchased by the wastewater management agency.
- b. All land required for pipelines would be acquired by the agency under a permanent easement
- c. The agency would own and operate all treatment facilities, transmission facilities, storage reservoirs, and reuse system components.

- d. Wastewater and sludge application areas would be acquired by use contracts botween landowners and the wastewater management agency.
- e. The agency would furnish and the landowner would operate the underdrain system, runoff control works and distribution system. Use contracts would pay the landowners to operate these systems in accordance with needs for wastewater treatment.
- f. Landowners would operate the wastewater application system and the sludge application system as well as being responsible for farming operations in both the wastewater and sludge application areas. All profits from farming operations would be retained by the landowners.
- 222. The costs for each wastewater alternative using both types of land acquisition concepts were based on an interest rate of 5-1/2 percent. Pipeline costs were determined by the type of construction, design pressure, and pipe diameter; pumping station costs were based on pumping pressure and horsepower requirements; and treatment plant costs were based on the quantity of wastewater being treated and the types of treatment required. Table 32 provides a summary of costs for the Base Condition, each wastewater management alternative and the tertiary treatment system based on the fee purchase concept. Table 33 summarizes the costs for the B- and D-Series of wastewater management alternatives based on use contract operation of the land application sites. It should be noted that total construction costs for alternatives are incremental to Base Condition costs. The average annual costs for each alternative do not vary greatly between the two land acquisition concepts. Costs for the tertiary treatment system were developed on the basis of fe purchase of all system-required lands, since there would not be any land requirements for wastewater application and only a small amount of land required for sludge application.
- 223. As indicated previously, it has been assumed that recollected water at each landsite would be available for flow augmentation to local streams at project year 2000. Only at Land Sites 4 and 43 (Reuse Alternatives 1, 45 and 47) would additional costs for conveyance and pumping be required for flow augmentation. Using the use contract concept average annual costs (in millions) for each wastewater management alternative including flow augmentation reuse is as follows:

Alternative B-1 - \$447 Alternative B-2 - \$355 Alternative B-3 - \$482 Alternative D-1 - \$437 Alternative D-2 - \$366 Alternative D-3 - \$47

^{1/} Although preliminary screening of alternatives was based on an interest rate of 5-3/8 percent, final costs were developed using an interest rate of 5-1/2 percent.

TABLE 32

FEE PURCHASE ESTIMATE SUMMARY

	Base		WASTE	WAS TEWATER MANAGEMENT ALTERNATIVES	TENT ALTERNA	LIVES		Tertiary
	Condition	B-1	B-2	B-3	17	D-2	P-3	System
Description	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(81,000)	(\$1,000)
Construction Costs	1,500,000	2,800,000	2,300,000	3,300,000	3,300,000	2,900,000	3,800,000	2,100,000
Total Construction Costs	1,500,000	2,800,000	2,300,000	3,300,000	3,300,000	2,900,000	3,800,000	2,100,000
Annual Costs								
Base Condition Facilities Capital Cost 1/ Alternate Facilities	76,600	46,600	46,600	46,600	46,600	76,600	46,600	009,97
Capital Costs	1	123,600	102,200	146,500	146,200	129,100	168,800	91,800
Replacement Costs	8,900	27,200	21,200	29,300	27,700	23,200	30,700	19,000
Operations and Maintenance Costs	65,000	250,000	190,000	270,000	220,000	180,000	250,000	200,000
Total Annual Costs	120,500	447,400	360,000	492,400	440,500	378,900	496,100	357,400

To compensate for the depreciated value of existing Base Condition facilities, 50 percent of the annual costs for new construction was used. 1

NOTE: Alternative and tertiary treatment system total construction costs are incremental to the Base Condition.

TABLE 33

ONTRACT OPERATION OF LAND APPLICATION SITES ESTIMATE SUMMARY

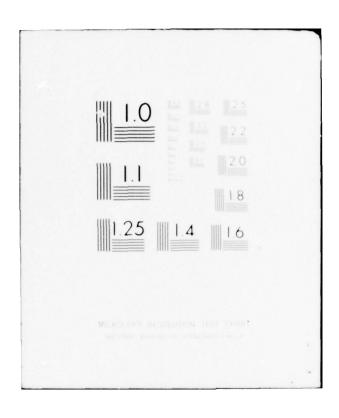
		ALCOHOL ACIDAL				
		WASTEWA	WASTEWATER MANAGEMENT ALTERNATIVES	ALTERNATIVES	0 4	6 4
DESCRIPTION	(1,000)	(1,000)	(1,000)	(1,000)	(1,000)	(1,000)
Construction Costs						
Government Owned Facilities	2,300,000	1,700,000	2,500,000	2,650,000	2,150,000	2,900,000
Contractor Owned Facilities	300,000	300,000	400,000	350,000	350,000	700,000
Total Construction Costs	2,600,000	2,000,000	2,900,000	3,000,000	2,500,000	3,300,000
Annual Costs						
Government Owned and Operated						
Base Condition Facilities Capital Costs 1/	46,600	46,600	46,600	009*97	009,000	76,600
Alfernate Facilities Capital Costs	99,500	73,800	108,000	114,500	92,900	125,200
Replacement Costs Operation and Maintenance	170,000	110,000	170,000	15,200	10,800	130,000
Subtotal	332,900	241,300	340,600	306,300	235,300	316,900
Contractor Owned and Operated						
alvernate Facilities					4.4	
A Language Costs	10,300	10,300	13,200	13,000	13,000	15,000
	000 06	30,000	110,000	100,000	100,000	150,000
	113,100	113,100	140,300	128,000	128,000	152,100
	446,000	354,400	480,900	434,300	363,300	000,000
			sdition facility	value of existing Base Condition facilities, 50 percent of the annual costs	it of the annue	1 costs

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egreciated value of existing Base Condition facilities, 50 percent of the annu

. continue to the farmental to the Base Condition.

CORPS OF ENGINEERS SAN FRANCISCO CALIF SAN FRANCISCO--ETC F/G 13/2 LAND APPLICATION ALTERNATIVES FOR WASTEWATER MANAGEMENT FOR THE--ETC(U) AD-A043 893 MAR 75 UNCLASSIFIED NL 3 or 3 END DATE-FILMED 9 -77



Costs do not reflect any consideration of financial benefits which might be achieved from the use of reclaimed water and fertilizer. Construction costs and annual costs for the selected reuse alternatives are shown on Table 34. As indicated earlier under the section on Wastewater Reclamation Opportunities, Reuse Alternatives 2, 8, 17, 25, 37, 41 and 43 have no additional costs.

COST SHARING

224. For the past several years, it has been the practice for the Federal Government to share the construction cost of publicly owned wastewater treatment works with local interests. In 1970, with the passage of the Clean Water Bond Act, California became a partner to the concept of cost sharing. Present State and Federal policy, as expressed in the California Clean Water Bond Act of 1970 and its amendments and the Federal Water Pollution Control Act Amendments of 1972, indicate that the sharing percentages of eligible portions of project costs are as follows: Local interests - 12.5 percent, State of California - 12.5 percent and the United States - 75 percent. Grants are made for eligible portions of project costs subject to rules and regulations established by the California State Water Resources Control Board and the Federal Environmental Protection Agency.

225. With respect to granting procedures, the term "construction" has been given a broad meaning and includes, in addition to the actual building and alteration of works, all the necessary planning, engineering, legal, fiscal and economic investigations necessary for the implementation of a project. With respect to eligible portions of project costs, Federal statutes indicate that "treatment works" include devices and systems used in the storage, treatment, recycling and reclamation of wastewater, or are necessary to recycle or reuse water at the most economical cost over the estimated life of the works. Land acquisition is an eligible project feature so long as the land is an integral portion of the treatment process or is used for ultimate disposal of residues. Reuse facilities also would be considered eligible project features if such facilities were necessary to the operation of the project. All grants made are subject to user charges and industrial recovery charges required by State and Federal statutes. Both the State of California and the Federal Government have established priority systems for the allocation of grant funds.

226. For the purpose of this study in allocating costs among local, State and Federal interests, it has been assumed that all features of the wastewater management alternatives are eligible for construction grants. Capital costs of the alternatives (and that portion of the average annual costs which represents amortization of capital investment) have been apportioned on the basis of 12.5 percent local, 12.5 percent State of California and 75 percent Federal. Cost for operation and

TABLE 34

SELECTED REUSE ALTERNATIVES

ESTIMATED AVERAGE ANNUAL COSTS COMPARISON SUMMARY

			-	TWOWN	ALICOL COSTS	
Reuse		Construction Costs 1/	Capital	Replacement	Operation & Maintenance	Total 1
Alt. No.	Description	(\$1,000)	(81,000)	1,000)	(\$1,000)	(\$1,000)
	Flow Augmentation to Suisun Marsh	4,200	170	10	80	260
	Industrial Cooling at Site 5	000.04	1,400	1.0	1,000	2,500
	Irrigation - northern portion of Area 5	48,000	1,670	103	1,000	2,770
	Flow augmentation to Petaluma River	11,000	450	77	280	750
	Recreation at Chileno Lake	5,100	220	5.3	06	330
	Flow augmentation to Napa River	14,000	570	30	390	066
	Flow augmentation to Napa River	27,000	1,100	08	006	2,080
	Irrigation in Petaluma Valley	36,000	1,470	09	670	2,200
	Irrigation in Petaluma Valley	51,000	2,090	06	1,100	3,280
	Irrigation at Castroville	25,000	750	20	330	1,100
	Groundwater Recharge - Eastside Area	14,000	430	07	270	140
	Industrial Cooling at Antioch	14,000	570	30	340	076
	Industrial Cooling at Antioch	16,000	650	30	330	1,010
	Flow augmentation to Local Stream	10,000	805	2	110	520
	Flow augmentation to Local Stream	000,94	1,870	10	200	2,380
	Industrial Cocling at Antioch	125,000	5,080	220	200	8,500
	Industrial Cooling at Antioch	000.44	1,790	70	950	2,810
	Industrial Cooling at Antioch	139,000	5,650	067	3,800	9,740

1/ Including contingencies, E&D and S&A.

maintenance and replacement would be paid by local interests. Landowners within the land application sites would be expected to pay a portion of these latter costs equivalent to their normal costs in operating irrigation systems.

INSTITUTIONAL ARRANGEMENTS

- 227. The institutions considered in this study include the governmental structures of the Bay-Delta Region which have emerged in relation to possible solutions of water quality problems. Governmental studies are concerned with the development, growth, and responses of wastewater management institutions associated with increased demands for allocation of resources to the solution of growing regional water quality and pollution problems. Particular emphasis is placed upon institutional impacts which may be related to land application alternatives of Bay-Delta water quality problems.
- 228. During recent years increasing attention has been given to waste treatment facilities to solve water quality and pollution problems. Institutional responses were concentrated at local governmental levels. In some instances, existing flood control or water supply agencies assumed waste treatment responsibilities in lieu of creating new single-purpose institutions. This type of institutional adaption was reasonable because flood control systems have often served in the dual capacity of providing both storm drains and sanitary sewers and water supply agencies are concerned with water quality as well as quantity. At the present time, it is generally recognized that the water quality and pollution problems of the Bay-Delta Region have grown to such proportions that the united efforts of Federal and State governments, as well as local governments, must be brought to bear and national as well as State and local economic and technological resources must be allocated to their solution.
- 229. It is anticipated that the Bay-Delta Region under the 1975 Base Condition will reflect increased institutional accommodation to meet legislative requirements of current and projected technological demands of an increasingly critical Bay-Delta water quality and pollution control problem. The emerging institutional environment will reflect an extrapolation of present institutional accommodation trends.
- 230. The selection of ultimate institutional arrangements to meet requirements of the selected wastewater management alternatives is the responsibility of State and local agencies and the voters. Interested and cooperating Federal agencies are charged with the responsibility of assisting the State and local agencies and to that extent may offer assistance as needed. Nonetheless, the decision-making process remains a State prerogative.
- 231. Existing institutional enabling acts of the State of California are generally flexible and adequate to meet most foreseeable needs; however, some changes may be considered in the interest of achieving uniformity and to assure that waste treatment management institutions will meet the criteria for construction grants.

232. The land application portions of the wastewater alternatives examined in this study would appear capable of being implemented by existing institutions. Only one governing institutional entity or wastewater management agency, should control each of the suggested land application subsystems. The formation of a new controlling district or the consolidation of districts could be handled by the local communities involved under existing legal authorities.

STAGING CONSIDERATIONS

- 233. An alternative is only a concept until it is implemented, then it becomes a program or a project. One of the problems common to all major public works projects is that of developing adequate and economic procedures for financing both the construction and the subsequent operation and maintenance of an alternative. To avoid potential difficulties in financing and administration, it becomes necessary to review financial and legal problems pertaining to public works projects. An engineering report can be of assistance by providing preliminary planning information.
- 234. The problem of how a particular alternative could be constructed and operated must be considered. All the facilities for an alternative could be built during a relatively short period of time, or a phased construction could be accomplished over a longer period of time. In order to determine which construction method would produce the best results, the following assumptions were used:
- a. All interceptor pipelines would be constructed at the same time;
 - b. All lands would be acquired at the same time;
- c. All wastewater storage reservoirs at the landsites would be constructed at the same time;
- d. Approximately 75 percent of the wastewater treatment facilities, the pumping stations, and the sludge handling systems would be built during the first part of the construction phase; and,
- e. Approximately 50 percent of the land application systems would be built during the first part of the construction phase.
- 235. Based on a review of the cost data, the effect of these assumptions would be that only about 25 percent of the construction cost could be considered for staged or phased, construction. It was assumed that all system construction, with design capacity to meet year 2000 flows, would be started by 1975 and completed by 1985. There could be a staging of a portion of total system construction during this 10-year period. Assuming a reasonable project construction period, of 10 years for initial construction for year 2000 flows, and six years for further expansion of facilities for year 2020 flows, a further breakdown follows:

- a. The number of major construction contracts would be approximately 500.
- b. Average duration for each construction contract would be 1-1/2-2 years, with the exception of storage reservoirs which would be 1-1/2-3 years. Numerous construction contracts would be running concurrently and would be staged throughout the construction period.
- c. The first two years of the 10-year period would be for basic engineering, design, and land acquisition, the remaining eight years for final design and construction.
- d. Experience on construction projects indicates the peak rate of expenditure occurs at the 60 percent point of the construction period. Design and construction expenditures could be staged based on these assumptions. Figure 9 schematically depicts the time phasing for design and construction costs.

YEAR 2020 MASTER PLAN

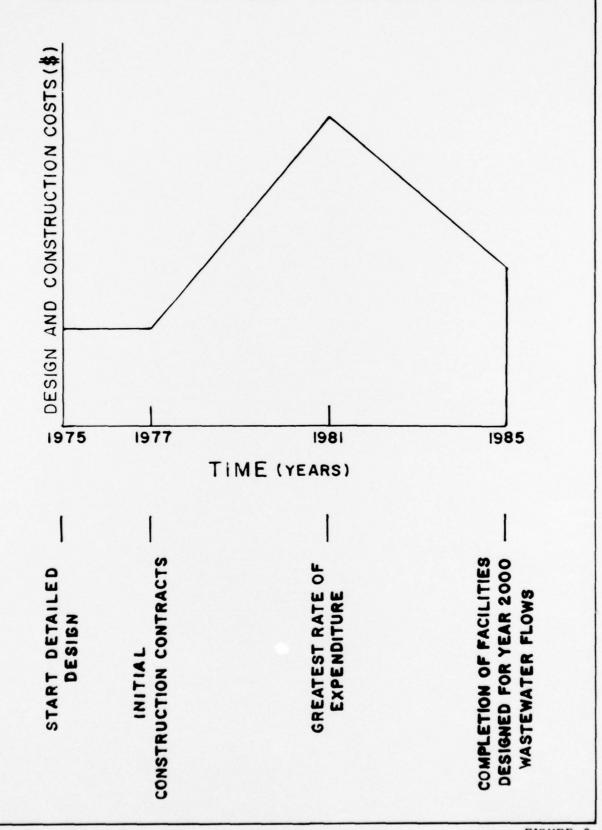
- 236. The six wastewater management alternatives developed can be considered only as intermediate steps in meeting long-range water quality needs. Each alternative can be expanded into a master plan to care for wastewater flows and constituents for the year 2020. As an example, Alternative D-1 was modified to demonstrate the compatibility of the year 2000 land application alternatives with long-range planning. Alternative D-4 (see Plate 34) can be considered as the 2020 Master Plan for the D-Series of wastewater alternatives. Since this alternative is the same as Alternative D-1 except for the quantity of wastewater being generated, the same land application sites used in Alternative D-1 would be used. The amount of land required would be increased but would generally be in the same location as that used under Alternative D-1.
- 237. Sludge System S-5 (see Plate 35) applies to Alternative D-4 (year 2020 Master Plan) and is similar to Sludge System S-2. In System S-5, the sludge from Sites 42 and 43, as well as that from the Central Contra Costa County Wastewater Treatment Plant and the three small tertiary plants on the Sacramento River, would be conveyed to Site 5. All other routes would remain the same as in Sludge Systems S-2.

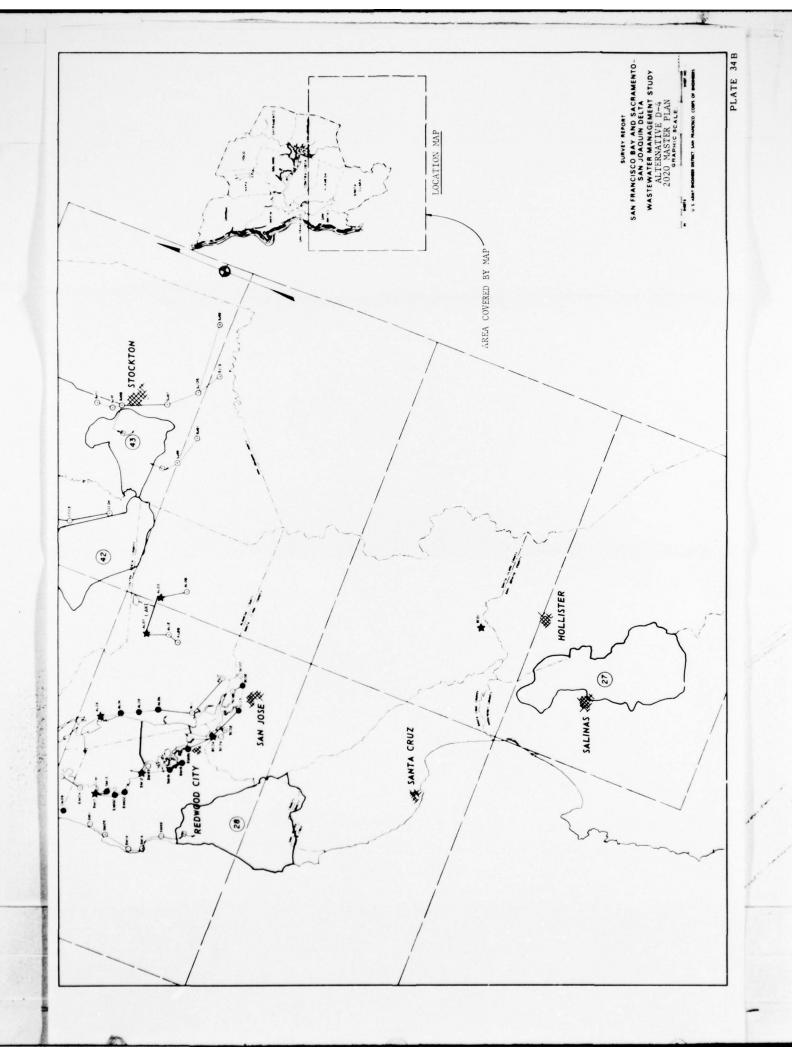
SENSITIVITY CONSIDERATIONS

Introduction

238. Changes in assumed design criteria could result in changes or modifications to wastewater management alternatives. The sensitivity of these possible changes should be examined. The areas of greatest potential change

TIME PHASING FOR DESIGN AND CONSTRUCTION COSTS





in design criteria would be in the projection of wastewater flows (which affect the utilization of each land site), crop patterns to be selected, removal or use of existing orchards, cost development assumptions and the availability of land suitable for land treatment of wastewater.

Projection of Wastewater Flows

239. Projected final municipal wastewater flows were based on the population data presented in the Series D-150 projections prepared by the California Department of Finance. This series of projections is currently considered the standard for State and Federal planning in California, except when overriding reasons dictate the use of other projections. A second series of population projections also has been developed by the California Department of Finance, the Series E-O. E-O Series projections are based on reaching zero population growth at some time in the future. The Series E-O data indicate a smaller population forecast than the Series D-150 data (see Table 4). Current trends in population forecasting appear to favor use of the E-O Series as a frame of reference for future planning. Grant regulations and planning criteria of the State Water Resources Control Board for wastewater treatment facilities make use of these projections in critical air basins. The following counties are in a critical air basin and, as such, population projections could be less than those derived from D-150 Series: San Francisco, San Mateo, Contra Costa, Alameda, and Santa Clara.

240. Of these five counties, only Contra Costa and Santa Clara Counties would contribute significant quantities of waste to land areas. Use of the E-O projections would result in slightly lower wastewater flows to Site 42 for all alternatives and to Site 27 for Alternatives B-3 and D-3. Also less sludge would be available for land application because of reduced flows. Therefore, the land portions of the wastewater management alternatives presented in this report do not appear to be significantly sensitive to the choice of which population projection is used.

241. Initial coordination with industrial groups in the study area has indicated that the industrial wastewater flows could change depending on which set of technical assumptions were used. In this study, the flows were based on a set of industrial assumptions outlined earlier. The assumptions appear to be reasonable and since the majority of the industrial waste flows originate in Contra Costa County, changes would only materially affect the Site 42 portions of the land application alternatives.

Crop Patterns

242. Several basic assumptions were made regarding the various crop types to be used at the application lites. These assumptions were

made from the best available information. If this information changes, then the original assumptions might also change. As an example, available information from the agricultural community indicated that alfalfa would remove about 170 pounds of nitrogen per acre per year. The assumption made was that if nitrogen were available from the ground, alfalfa would utilize this form of nitrogen prior to fixation of any nitrogen from the atmosphere. Presently, no documented data have been furnished to determine if alfalfa does use one hundred percent of the nitrogen from the ground. Only through continued experimental efforts and pilot plant studies would definite data be available.

243. It also was assumed that no crops would be grown that are normally eaten raw by humans, such as tomatoes. If additional wastewater treatment processes were provided, the water could be used to irrigate crops used for direct human consumption. The additional treatment would consist of a dual media filter and chlorination unit. The treatment cost would be increased. For example, in Site 5, approximately 9,940 acres of tomatoes are currently grown which could be irrigated with 40 MGD of adequately treated wastewater. The additional cost of providing both filtration and chlorination would be about \$8.87 per acre-feet of water. Table 35 summarizes the additional cost of treating the wastewater flows to each site, for each series of alternatives, to allow continued cropping of tomatoes, asparagus and other desired crops.

Orchards

244. The original design for the application of wastewater contemplated removing all orchards affected by this application. This concept was considered because crops with good nitrogen removal characteristics were required to insure proper land treatment of wastewater. With this assumption, overall monetary losses would occur unless some of these orchards were replaced. It would be possible to develop new orchards in the proposed sludge application areas. From a cost standpoint, it would not pay to replace orchard crops such as walnuts and prunes. The development time required and recent decreases in harvest prices would make the replacement of these orchard types uneconomical. However, these particular orchards could be replaced by other types: almonds, apples, cherries, pears, and apricots. If orchards were replaced, the total net annual agricultural loss could be reduced or eliminated.

Cost Development

245. The final costs developed for this study were based on an interest rate of 5-1/2 percent. However, this interest rate could change depending on the total national economic situation. It is probable that the interest rate would increase rather than be decreased. This would result in increased costs for all wastewater management systems. If the interest rate increased, for instance to seven percent, an approximate 13 percent increase in average annual costs could be anticipated.

TABLE 35

ADDITIONAL COSTS FOR TREATMENT OF WASTEWATER TO BE USED ON EDIBLE CROPS

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3.8 1.8 5.6 80 4.8 2.5 4.8 2.5 7.3 81 4.8 2.5		218	11.9	6.8	18.7	218	11.9	6.8	18.6
4.8 2.5 7.3 81 4.8 2.5		55	3.8	1.8	5.6	80	4.8	2.5	7.3
		81	4.8	2.5	7.3	81	4.8	2.5	7.3

NOTE: 1/ Average annual costs.

Land Availability

246. This study used seven primary land application areas (Sites 28, 42, 43, 4, 5, 21, 18) and one alternate area (Site 27) for the application of treated wastewater and sludge. These sites were chosen based on several parameters discussed earlier. If certain sites were not to be used, such as Site 5 with a total of 192,000 potentially available acres, other sites which were identified but not investigated in detail could be used. Use of these additional sites would be expected to present a range of positive and negative effects comparable to those described in this report. Proposed use of the primary seven land application sites was based on their locations relative to the major wastewater sources. Other land application areas, such as Sites 38, 39, 41, and 53 (Plate 6), could be considered if a primary site became non-available. As discussed earlier, Site 27 was used in two of the six alternatives to provide an additional option to South San Francisco Bay area wastewater dischargers and to permit evaluation of the concept of interbasin transport of wastewater.

IDENTIFICATION OF IMPACTS AND SYSTEM PERFORMANCE

PUBLIC LAW 92-500

- 247. On 18 October 1972 the "Federal Water Pollution Control Amendments of 1972" (PL 92-500) became law. The law establishes two national goals:
- a. To achieve wherever possible by 1 July 1983 water that is clean enough for swimming and other recreational uses, and clean enough. for the protection and propagation of fish, shellfish and wildlife.
- b. To have by 1985 no discharge of pollutants into the nation's waters.
- 248. The law also increases Federal aid to help local government build sewage treatment facilities and sets the following deadlines for actions to control water pollution from industrial and municipal sources.
- a. Industries discharging pollutants into the nation's waters must use the "best practicable" water pollution control technology by 1 July 1977 and the "best available" technology by 1 July 1983.
- b. All publicly owned treatment works in operation on 1 July 1977 must provide a minimum of secondary treatment.
- c. All publicly owned treatment works must use "best practicable" treatment by 1 July 1983.
- 249. Insofar as possible, the water quality provisions of PL 92-500 have been considered in identifying the impacts and characterizing the performance of the final wastewater management alternatives.

IDENTIFICATION OF IMPACTS

Introduction

250. In the planning process sequence of events, impact identification falls between the formulation of alternatives and their evaluation. It serves as a bridge between these two planning events, as it supplies information to minish the former and to start the latter. When displayed, identified impacts describe the changes which will result from implementation of the final wastewater management alternatives. These impacts then become the indicators for evaluation.

Scope of Accounts

251. The first step in the impact identification process is to define a set of categories and impact parameters so that the impacts can be organized and assembled according to their effects on man and his surroundings. These categories represent areas of concern which planners have found to be essential in plan formulation and/or sensitive to public interest. For this study environmental quality,

social well-being, economic, and institutional categories were selected as representative general areas within which to identify impacts. Impact parameters represent those specific areas in which changes are likely to be produced.

- 252. Environmental quality involves the relationship between human environment and the natural environment. Many of man's actions affect the natural biological processes and life cycles of a region by altering the chemical or physical components of the natural environment. Usually the effects of these actions appear in the biological sector as either temporary or permanent changes in the growth, maintenance, and reproduction of organisms or the relationship that exists between biological communities and entire ecoysystems. By identifying changes in chemical/physical factors, ecological associations, aesthetics, recreation and use of natural resources, it is possible to assess the impact of an alternative action on environmental quality.
- 253. Social well-being involves a condition, existing or desired, expressed in terms of individual and group quality of life. This quality of life concerns those activities, institutions, and interrelationships of man involved in the maintenance, growth, and development of society within the physical environment. By determining the effect of an alternative on area viability (in terms of stability, growth and development of localities), public attitudes, distributive equity and public health, it is possible to assess social well-being sensitivity.
- 254. The development of water resources affects the environmental quality and social well-being of the region. In turn, these changes can affect the region's economic base and institutional framework. Although much criticism is given to the use of dollar benefits and costs in evaluating alternative solutions in the context of coexistence with environmental and social well-being considerations, the dollar aspect of regional development must be considered. In this light, information on project costs, agricultural production, public finance, land values, reclamation of resources, and changes in existing institutional structure is considered necessary. Table 36 summarizes the basic impact categories and parameters used in this study.

Matrix Preparation

255. After the impact categories and parameters have been established and the impacts identified and assembled, the next step is to develop a format for their display. It also becomes necessary to equate the impacts to the various groups that will be affected by the alternative. For this study, any change in the impact parameters could potentially have an effect on the San Francisco Bay-Delta Region, the State of California, or the United States. Although some impacts may be relatively unimportant the further from the study area a planner considers, their synergistic effects may be extremely important and therefore must be considered. In addition, the impacts produced from the interbasin transfer of wastewater need to be considered.

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TAME VALUES	PRESENTES AND NAY INTENDITIVE EN- MANCE LONG-TERN VALUE OF REPARTAS LAND THREE SEVERSAL OF VALUE OVALITY OSCIAZATION.	MINIMUM DARKET	MINIMUM (MINUTE)	MINIMUM IMPACT	PUSEBURS AND HAY ULTIMOTELY EN- BANCE LOSG - TERN VALUE OF REPARTAN LAND THREE SEPREMAL OF RATIOS GLACIYY DESIGNATION.	MINIMIN IMPACT	MINIMEN DOPACT	MUNISHER INPACT	MINIMUM INDACT
RECLANGING OF RESOURCES	MINIMON DEPACT	PROVIDES TEXATED MASTERATES FOR THE VALUE BUT TO MASTERATES AND STUDIOG AN	MARKOTTO NAKATED MARTEMATED FOR THE TEXTLACTOR OF \$1,000 ATMLS. PRETLICES ALDER DET TO MARTEMATER AND SULDGE APPLICATION OF \$1,400,000 PER TEXT.	MUNIMUM IMPACT	MINEREN INPACT	MINIMIN INDACT	TOACH MINISTR	MINIMEN INFACT	MINIMEN IMPACT
TRELITIONAL	LAND APPLICATION FOR INSTITUTIONS, JOLNY WATER MARKGREINT ACH CONTROL ANY ONE LAND	LAM AFFICATION PORTION COLLD BE DELEMENTED BY EXCITING OR ALGORITY WOUTHER STREET TRANSCORP COLLEGES AN ASSENCE OR CURSTON OF A NEW ANITO-MARK AMAGENET AN COLLEGES AN ASSENCE OF OR ENTITYTION, ADDRESS AND CONTINUES AND ANITO-MARK A	DR SLIGHTY WOIFFED TATION OF A SISS ANSTE- TUTIONAL AUTHOR SHOWED	SENERGY INPACT	MINISH MARKET	IN CHARMAL, STATE STATUTES ARE ABRUCATY TO AID IN DWILDSHIPTING LAND POSTION.	S ARE ABRUGATE TO ARE IN	IN GENERAL, PEGERAL STATUTES ARE ADEQUATE TO ALD INFLIGHENTING LAND PORTION.	S ARE ADSOURTE TO AID IN

A. COST SMALNE FOR FIRST COST (a.2 AMMITIZATION) AND 12-5 FORCEST LOCAL, ILL.5 FORCEST START OF CALLPROSEA AND 75 FORCEST FERBOAL.

N. REPLACEMENT AND OPERATION AND MAINTENANCE COSTS WERE CONSTITUTED TO RELOCAL MESPERSTREETT.

2) VALUES ARE INCREMENTAL TO THE MASE CONDITION.

PARAMETERS PCPULATION EXCHANGE TERRS PCPULATION EXCHANGE TO TREATER TO THE MEDIA CONDICAL PRINCIAL PATTOR CONDICAL PATTOR CONDICAL PRINCIAL PATTOR CONDICAL PATTOR C	SAN FRANCISCO BAY – DE SITE POPULATION FARMERAS THE POPULATION FARMERAS THE POPULATION FARMERAS THE POPULATION FOR PRINCIPLE SERVICE TO SERVICE THE SERVICE FOR PRINCIPLE SERVICES FOR PRINC	SCO BAY - DEL PULATION SETTLE MENTS RESTREE PERMENTS RESTREE STATES RESTREE SATISTICS RESTREE RES		INTEREST GROUPS SEE SWEET SANS AND GRALIN GROUP PS SEE SWEET SWEET SANS AND GRALIN FLANDS, GRANGELS OF SECREDAL FLANDS, GRANGELS OF SECREDAL FLANDS, GRANGELS OF SECREDAL FLANDS, GRANGELS OF SECREDAL MAGINETICS FROM THE AND SECREDAL SANS E FROM SECRETAR SANS E F	GENERAL PUPULATION MEETS SENET-AMENT UND ATTENTION OFFICE STATE STATE OF THE STATE	CALIFORNIA CONVEYANCE INTEREST GEVERAL INTEREST NE POPULATION GROUPS POPULATION GROUPS TITS ABOUT 558 MILLS OF ETTE: ABOU	GENERAL INTERES PCPULATION GRUPS	STATES INTEREST GROUPS
S SENERAL PCPULATION MARTINE WITHOUT THE THE CONTROL OF	SITE P FARMERS FARMERS FARMERS FROM FROM FROM FROM FROM FROM FROM FROM	PULATION SETTLEMENTS SETTLEMENTS SERVED SE	- 34 8 E34 98 8 98 98 98 98 98 98 98 98 98 98 98 9	INTEREST GROUPS STEP INSTITUTE AND AUGUSTALIA FORWERS GROUPS FORWERS GROUPS FORWERS GROUPS FORWERS GROUPS FORWERS GROUPS FORWERS	GEVERAL POPULATION MERS SENERANDE UNITS OXYMMETS TO SENERA	INTEREST GRCUPS Restrict corners scale.		INTEREST
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THE STATES PARTICING SCHARING	TREATEM, DOROUGHEST OF MARKET TO MARKET TO THE SERVICES. PRODUCES. THE OFFICE OF THE SERVICES, DESTINATED AND SERVICES. IN SERVICES AND SERVICES. IN SERVICES AND SERVICES AN	MODITION. MODIS OF WATER ASE NOW ANTER ASE NOW ASELS OF THE PRINCIPLE OF THE ASE NOW ASELS ASE NOW ASELS ASE NOW ASELS ASE NOW ASELS ASELS AS NOW AS NOW ASELS AS NOW ASELS ASELS AS NOW	THORSEN INCRESS IN WITH AND THE AND THE AND THE AND CONTROLLED STATES OF THE AND THE A	PROTEST AND AND SCHOOL OF COURSE AND	OXYX CACTS TO BEHING THE PULLETTE		NOT. OCCUPATA, THE ALTONO	ET LOSC-MADE GALS DY SET PLANT CHRENET BILLS THE MEETS IN \$1-100
RESOURCE THE STATE OF BEINGUE, RESULT STATE	THE OWN THE STATES MEAN, INTERIOR THE OWN TO STATE STATES AND STREET THE AND STREET THE AND STREET THE AND STREET STATES AND STREET ST	SISTEMA IN DOCUMENTS TO THE TOTAL STRUCTURE TO THE STRUCTURE TO THE TOTAL STRUCTURE TO THE STRUCTURE TO THE TOTAL STRUCTURE TO THE	18550 58 8550250			A OF GRADULT MONING IN THE STAIR.	CANTISITES TO THE MADE TO THE	CONTRICTOR OF MANAGEMENT OF SETTINGS, SOUTH- TONE, PRECISE, CONTRIBUTED TO ANALOGY, DEFENDED. MENTAL, SPALLTY SOLARS.
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OOKERN OF FYSIEN TITLES TO CONTRACT TO CON	K	MINIMAL NOUSING DISHUPLION.	TSC. FACILITIES OF PARKS AND PERSONAL POSTBALL MIXON DOSESSO DESAURTION WITHIN TREAS ONE AND AS OF ALIGORETIC	13,000 ACRES OF THE CORP CRAMES IN THE	Total Markin	POTRITIA, ALTEGATIS OF WINCOS EFFECT DI SER LIDENCA ANNO 1886 EFFECT DI SER LIDENCA ANNO 1886 EFFECT DI SER LIDENCA ANNO 1886 EFFECT DI SERVICIO IN SERVICIO ESAT OF SERVI-	Mission 199 ACT	PETERTIA ALTGATIN DE WANTEN DEPART PER MICHAEL LADO.
T WOLLDW T	CONTINGS OF SYSTEM TO PORCE STAMEN- CAST ALTRACTION TO ARE OPERATION AND PROCESS. AS WHATEN AND ASSESSMENT OF MARKET AND ADVISING PORTIC HEALTH REPERTY.	CONCERN OF RESIDENCE ALTERATION OF BRANCE, INTER-STRILL, AS WITH, THE AS AS AN INCLUDE OBSERVINGS, IN TOTAL WITHER WATER STREETS, AND STREET OF FRANCE AND AND STREET OF THE STREETS.	LISA 400 PORTRIANS, STATUCE LISA 400 PORTRIAN ALCONOMINA PARTENNA , DEP DO ACCESS DISBURDO DO, LINE, DONC, NO PAYSE BRANCH DO INCLUDE PRASE.	MAXILTY OVER LOSS OF ROAL STRICT- THE AND CODESTOR AND STRICT- GORD'S. SEETLINES AND STRICTS-AND STRICTER STRICTS OF STRICTS OVER ACCESS OFFICER STRICTS OVER STRICTS. OFFICERS OFFI OFFI STRICTS OVER ACCESS OFFICERS OFFI STRICTS OVER STRICTS. STRICTS OFFI STRICTS OVER STRICTS OFFI OFFI STRICTS OVER POST DAYS. DEVELORATION STRICTS OVER POST DAYS. DEVELORATION STRICTS OVER POST DAYS.	MENDER DRACT	CONCIDE OF REGILAT WINNESS OF ACTUAL ON HERMAN MATERIALIS ONE TO CHAP CHAPTER CHAPTERS.	DVAKE KONTEN	OWERS OF SCHAME SIRKERS TO CHEEK AND THE STREET THAT THE STREET TO CHEEK CHARETS.
	TREATED OF 30 WILLING MAN ANTE OF MARE POSESTED FOR STATES CONSTRUCT THE WAY TO SERVED OF THE SON WILLIAM OF THE STATES AND STATES FOR MARE TO SERVED OF THE SON OF THE STATES OF THE SON OF THE SON OF THE STATES OF THE SON OF THE SO	POTESTAL OF 25 WILLIAM AND MAYE WINDER TOR STATEM TORSTRUCTION. WERE WINDS SECURE TO THE STATEM STATEM, AND STATEM STATEM, AND STATEM STATEM, AND STATEM STATEM. WILLIAM STATEM STATEM STATEM STATEM STATEM STATEM, AND STATEM STATEM STATEM. POTESTAL ONE WORLD TO STATEM STATEM STATEM STATEM STATEM STATEM. WERE WERE WINDERS OF STATEM STATEM. SHALLON.	0024636428	- T	PERSITAL PETEACTOR OF SOME CON- STRUCTOR MORESS. ISPICIALLY PROM- NORSTIAL SIGNIFICANT MARK OF PORTOTAL SIGNIFICANT MARK OF PORTOTAL SIGNIFICANT MARK OF STRUCTION AND OAK.	CONTRACTOR POSSIL OPERATOR TO CONTRACTOR A POSSIL OPERATOR POSSIL POSSI	TOANG MINERER	WATERIAL MANTACTIRES AND FEMALE OF STATES ON STRUCTION.
PRISAL CHARACTER REGISTERS GRACK AND TOXIC PRINCE OF TOXIC PRI	THE ALTHOUGH WILL INCIDENT ACTION AND VOTIBBLIS WITHOUT WILL INCIDENT ACTION OF THE PRINCIPLE WE CONTINUE OF AGENCY OF THE CONTINUE OF AGENCY OF A	PRODUCED STREET WITHOUT PRODUCED STREET	MINIMUM IMPACT	TRIS ALTREASTIVE WILL INDIGATE THE COMPRISELY SHELD DRING TRICKERY IN STUALING AND OCKAS WATER.	MEETS THE APPROPRIATE REGULATIONS	DAME. SERVE THE APPROPRIATE REGILATIONS OF CALIFORNIA STATE MEALTH ACTOCUSA.		SOUTS THE APPGUPLIATE BEGLATIONS OF PRESAL.
	PORTIONS OF THE CINEMA, PORTLATION OOSTS WILLD BE SOME FOLLOW. LANG- ANDRES REPLACED TO THEIR WORKEL OOSTS OOK ENSEMALED AND PREFAING CONTRACTOR. RESIDENT AND PROPERTING CONTRACTOR. RESIDENT STORY.	MINIMUM IMINCI	MINIMIN MBACE	MINIMON IMPACT	CAPITAL COST ASORITZ. SI TOTAL A. A. COST	000,024 000,417	CAPITAL COST \$102,000 FOTAL A. A. COST	31,500,000
PERAL POPULATION.	RESTRICTED TO CROMING ONLY RIGH NIES WHICH ARE NOT SATEN RAW. ANSTREATER STREET INSTALLED ON FAMILIES FOR YOUR YEST ON AND THE YEAR ON A NEW TEN YOR AND THE YEAR ON A NEW TEN YEAR.	ROGEN ULING CROPS AND CROPS RAMB DRAIN APPLICATION Y, MILL BE COMPENSATED ON MY NODWENTANCE OF LUSSIES	MINIMUM IMPACT	MINIMIN IMPACT	MINIMUM INPACE	MINIMUM IMPACT	AVERAGE ANNUAL ACRIGHTURAL INCOME LOSS \$683,000. INCOME GAIN AT YEAR 2000 OF \$108,000.	HINIMIN IMPACT
	MINIMUM INPACT	MINIMUM IMPACT	MINIMUM DARACT	HINIMUM IMPACT	MINIMIN IMPACT	HINIMS INDACT	HERININ INPACT	MINIMUM IMPACT
PRESENTE AND MAY ULTIMATELY IS- MANCY LONG-TERM NALING OF REPARTAN LAND THEIR REPERSAL OF MATER GEALTY DERMANATION.	MISDAIN INPACT	MINDEN DRACT	MINIMUM IMPACT	PRESENTES AND MAY ULTIMATELY EN- blance LONG-TERN VALUE OF RIPARIAN LAND THRU REVESSAL OF WATER ORALITY DEREMANTION.	MINIMIN IMPACT	MINIMUM IMPACT	HINIMON IMPACT	NINIMIN IMPACT
SININGM IMPACT	PROVIDES TREATED MASTEMATER FOR THE IORIGATION OF 91 000 M MES FORTI- LIZER VALUE DUE 10 WASTEMATER AND SIMBOR APPLICATION OF 81,400,000 PER	RIGATION OF 92 OOG M.MES. PERTI- 6S APPLICATION OF \$1,400,000 PER PRAK.	HINIMON IMPACT	MINIMUM IMPACT	MINIMON IMPACT	MINIMIN IMPACT	MINIMUM IMPACT	MINIMUM IMPACT
LAND APPLICATIONS. LAND APPLICATION PARTING CHIEF IN EMPERATOR IN STATEMENT OF STA	E IMPLEMENTED BY EXISTING OR SLIGHTS MENT OR CREATER OF A NEW MASTEMATES TIONAL ACENCY SHOULD CONTROL ANY ONE	LA MOLFIED INSTITUTIONS. SE MANAGEMENT ACROST ARE RE LAND AFFELIATION SOB-	MINIMUM IMPACT	MINIMUM INDACT	IN GENERAL, STATE STATUTES ARE ADEQUATE TO ALD IN THRESHING LAND PORTION	ADEQUATE TO ATD IN IMPLEMENTING	IN GENERAL, FEDERAL STATUTES ARE ADEQUATE TO ALD INFLEMENTING LAND PORTION	ES ARE ADEQUATE TO AID IN

1) THE FOLLMENC ASSMETIONS WERE MORE IN APPOSITORING PROJECT COSTS:

1. COST SMALDS FOR FIRST COST CAND ANNITIANTION WAS 11.5 PERCENT DOCK.,
11.5 PERCENT NAV OPERATION AND WINTERMACE COSTS FOR CONSIDERED TO
18. COCAL METANGRISHITTS.

2/ VALUES ARE INCREMENTAL TO THE BASE CONDITION.

Auto-			SUMMARY	OF IMPAC	375	UCED BY	ALTERN	ATIVE B-	3	
Public	MADACT		SAN FRANC	SISCO BAY - DEL	TA REG		CALIF	FORNIA		
	PARAMETERS		SITE PO FARMERS		CONV LINE PO	INTEREST GROUPS	GENERAL	GROUPS	SE P	=
	K-TORS	PROVIDES REST PRACTICARIE TREAT- NUMBER TEXTROLOGY IN PROJECT YEAR 2000. NINETY-EIGHT PERCENT RE- MOVAL OF PROSPHORUS, NITROCEN AND 8.0.D.		1.8. OF LOCAL STREAMS. 1.0.S. OF LOCAL STREAMS. 1.0.S. OF AROTHERS. EMEXT OF REFER LOKES.	REQUIRES ABOUT 430 MILES OF PIPE- LINE. SHORT-TIME DISCUPLION OF PHYSICAL PERTINES OUR TO CONSTRUC- TION.	MEES WATER QUALITY PLANTING OBJECT- TYPES OF EMILONAL PLANSING ARENITS. ASSISTS IN INSIGHENG OPEN SPACE PRESERVES.	MENTS THE INTENT AND THE UTATE MATER SESSI	IN TIME PRESTING COALGO OF CORES CONTROL NOALGO	MOUNTS THE INTENT AND PUBLIC DAM 92-500.	TIME PRANTING GOALS OF
		HARANES MATEN ORALITY IN THE ESTIGAT, HENCE ENGANCES THE VLARILITY OF THE MELION'S ESTORIN FIRST ACCOUNTS RESOURCES. ALLONS MATERIAL RESURENTION OF WATERWAYS.		MASTRAT FOR DESTABLE SWALL IN STRUCT PRESERVES S OF WATER AND NEW WATER	TEMPORARY INCREASE IN MILES AND DOST DORING, CONSTRUCTION WITH ASSOCIATED BENEVIS ON WILLILIES.	PHOYIDES RATES AND RESOURCE RE- CYCLING. PROPOTES WILDLIFE MAKALDHENT.	CONTRIBUTES TO THE POLITION WATERS OF CALL	OWENTE COAL OF RESISTING OF THE BRIAND AND OCEAN DONN'T A.	COMTRIBITES TO THE M MATGROOM, SPECIES, ENVIRONMENTAL GRALITY	CONTRIBUTES TO NATIONAL CONTRIBUTES TO NATIONAL
		SPRANCES THE SUTURN BY REDUCING THE PUTENTIAL FOR ALCAL SLONG. ELINIMIES UNSUREN SENACE DUT- ENAL PLONES. INSURES DENS SPACE CREEN ARAS.		NA AREAS: INCREASES FLOW DUPMENTS MAY, IN SOME TURAL ABSTRETTE VALUES.	INCREASED CONSTRUCTION ACTIVITY. POTENTIAL POR DEVELOPMENT OF CREEN RELTS. POSSIBLE REDUCTION IN SCENIC VALUES.		COMBATIBLE WITH WATERWAYS PLASS. HIGHWAY PLASS.	CALIFORNIA PROTECTED NN CALEFORNIA SCENIC	KIMINIK	- DRACE
		DECREES AFTER CONTACT STORY OPPORTUNITIES IN THE SETULAT. FISHING IS THE SETULAT. FISHING IS THE SETULAT. STORY TESTING AND STORY SHALL HINT- THE SETULAT. THE SETULAT. THE SETULAT. THE SETULAT. THE SETULAT. THE SETULAT.		N UPLAND GAME BUNTING MEDNITAL.	POTENTIAL FOR MAKING AND BICYCLING FATHS, AND MINI-PARKS.	INCREASID DEVIZORID AREAS.	INCREASE IN TOTAL B	RECEIVATION OPPORTUNITIES.	INCREME IN TOTAL R	GREATICA OPPORTURITIES.
The control of the	USE OF NATURAL RESOURCES	NINEMEN DRAFF	97,000 AURES POR MAS. 48,250 AURES FOR SLOT 2,350 AURES FOR LAGS 9,800 AURES FOR MASS	MATER APPLICATION; R APPLICATION; TRIANMENT FACILITIES; MATER STORAGE FACILITIES.		MINIMIN IMPACT	HINIMIN INPACT	MINIME EMPACE		905 TORS/DAY OF TREATMENT CHEMICALS; 11,350 MEGAWATT BOURS/DAY OF PRIER; 18,900 CHELF FEET/DAY OF NATURAL CAS ARE REGULED.
Part	NEA TABLLIT	SYSTEM ONGS PATENTALLY SEE TO OFFICE AND OFFI	N. AND ACTES OF CITOF CHARLES AND ACTES OF CITOF CHARLES AND ACTES OF A ACTES AND ACTES ACTES AND ACTES ACTES AND ACTES	STILLMENTS, 1300 OAS STILLMENT	NEMACT BASICALLY TRANSITION, WITHS SOME POTENTIAL BIOSTESS INCOME LISS. THORSELY OF A LICENSEAS INCOME. LISS. THE STATE OF	NO. 000 ACRES OF THE CADE CRANGES WHILE YEART THE PROPERTY OF THE CRANGES OF THE CADE CRANGES OF THE CADE CRANGES OF THE CADE CRANGES OF THE POPULATION AND EXPRENT OF THE CRANGES OF THE POPULATION.		PERMITAL LATERATION OF WARDS DERVISOR FOR MIGHTON NAME, 2009 OFFICKATION CHARACTOR OF WAND PRO- CASSING KAMACTOR OF THE PRO- CASSING KAMACTOR SERVICIALLY PRODUCTION DESCRIPTION IN ANCHORA PORT OF SERVICIALLY IN ANCHORA PERIOD STATE.		PETENTIAL ALTERATUM OF WHOSE BENAND FOR REGIONAL
The part Par	rostic attribles	CONCERN OF STREET PETELT TO PROSENT TO PROSENT TREATMENT OF RESIDENCE SAME DEPOSITION OF ACTIONATION AND ASSESSMENT STREET	CONCERN OF STEED IT REACH STORING AND ALTHACTAN TO REACH STORING TO AND ADDRESS OF THE AN SPORTS OF A AUTHOR PROPERTY OF TAKEN TO PRECED.	COMERN OF STSTEM TO FORCE ALTRA- ALTON ON BRAD, LEFSTER, AS WILL, ALTON AND BRIGHE THE STREET, AS WILL, FORESTER, AND	PRODUCTIBLE OF VARIOUS, STRVICE INSTANCE AND ADMINISTRAL ALLOSANY SERVICES, ONLY NACIONAL SERVICES REPLIES ONSTRUCTION PRACE.	MATTON 1978, LOSS IN SOLAL NEUT- THE AND ORNELOM ANNO, SORE CHRISTIANS, CONCERN, OF ROSSESS AND ENVICES. STARTINE REMEINS OWN ACCESS OLS. STARTINE REMEIN OWN ACCESS OLS. STREAMS OF TORINEST AND RESERVATION STREAMS OFFE FOR THE INVESTMENT OF STREAM.			NESTRON TRONCE	CONFERS OF STGANT WENESS OVER ARKDULTBAL SHE BENNES OWNESS.
	0.1108		PRINCIAL OF 28 KILLION NAS DAIS OF STOL MACES SCHOOLS 11, AND STALLIN STOLEGAS OF TOTAL SACE OF CONTI STALLION FOR KINNELTY SACE OF CONTI AND STALLING SACE OF TAXABLE AND STALLING SACE SACE OF TAXABLE AND SACE OF TAXABLE SACE OF TAXABLE AND SACE OF TAXABLE SACE OF TAXABLE AND SACE OF TAXABLE SACE OF T	NEWS WITHOUT THE CONTINUE CONSTRUCTION. FOR PORTAL STSTEM, 725-8 KILLION FOR BUCTION. KINS PLACE WOLLD NE 5,000 TO 7,000, LLION.		CONTRACTOR SHOWS CONSECUTION CONTRACTORS AND WINNESS AND STORY MONTHALTERS AND WINNESS AND STORY AND STORY CONTRACTORS AND STORY CONTRACTORS AND STORY MONTHAL BE APPORTED BY STORY MONTHAL STORY MONTHAL STORY MONTHAL STORY MONTHAL M	PRIDITAL IMPLIBATING OF SOME OMNUMENTO STREAM, NOW SOWING WART OF STALL (BUILD TO PRINCIPAL SIGNIFICANT SHARE (BUILD EMPLOYERS) WARS WELL ON- STRUCTION AND OMN.	CONTROL WAS CONTROL OF THE CONTROL O	MANNEY INDACT	MATSLAL MARINATERES, AND MASSPERATERS AND SECURITY STREET IN SHARE OF SYSTEM CONSTRUCTION.
		THIS ALTERNATION MAINTAINED DRAWS WASTERLINE AS A SOURCE OF TOLK WETAL CONTROL OF THE SETTLANT THOROUGH THAN A TOOL SEVERILE AND THE CONTROL OF WATER DRAWS IN WITHOUT DELAKE OF WATER DRAWS IN WITHOUT DRAWS OF THE SETTLANT OR WERELAND COMPITION.	THE ALTERNATOR VILL INCREASE ANTHA ASTAM, POPULATIONS, AND INCREASE THE STANDARD SINCE IN PARTICL DITTOR OFFICE AND TO SEALTH.	HOTOLAND VERTERATE NOTANCE POTENTIAL FOR ZONOTIC DESASE FOR GREATER CONTROL OF AGREDICITIBAL		THE ALTHROATUR WILL ENGAGE THE COMPLECIAL SHELLFURIES TOROUTY IN USTLOAUR AND OCCAN SATERS.	1	OF CALIFORNIA STATE SUBLIN ASSAULTS.	METS THE APPROPE POSTAAL NEALTH AS	RACIES.
STREET S	1/ 2/ COSTS (\$1000)	CAPITAL COST \$ 22,000 \$ 940,000 OAR \$ 22,000 \$ 0AR \$ 20,000 S ARS \$ 1000 S ARS \$ 10	POSTIONE OF THE GREEKAL POPULATION COSTS WORLD BY LOCAL LAND-MANNESS EQUITABLE NOT THE RESEARCH CONTRY FOR INSTALLING AND OFFEATING CONTRY FOR THE TON WAYNES.	MINIMUM DARACT	STRINGS DANCE	MINIMUM IMPACT	1 10	-	150	
TAX 1655 FOR PRICAMENT LAWER STEATER S	AGRICULTURAL PRODUCTION	EMAL FORGLATION STATES.		MORAN USING CROPS, AND CROPS WHICH ARM APPLICATION SYSTEM INSTALLED ON THE ON AVERAGE SAO PER ACKE. PER YEAR	NUMBER INDACT	NUMBER DEPACE	MINIMUM IMPACT		AVEXATE ANNIAL ACKITUITIBAL INCOME LOSS SATI, DAR. 1N- COME TAIN AT PEAR 2000 OF STED ONG.	TOWN MINIM
SECRETOR AND RESIDENCE OF ACTUAL OF	PUBLIC FINANCE	TAX LUSS FOR PURCHASED LANDS \$165,000.		MINIMEM IMPACT	MINIDOM IMPACT	MINIMUM IMPACT	MENTHEN THRACT	MINIMUM IMPACT.	MINIMIN IMPACT	MINIMUM IMPACT
PRODUCES RESOURCES RESOURCES PRODUCE OF A SECURITY AND A SECURITY OF A SECURIT	SAUDY VALUES	PRESERVES AND MAY ULTIMATELY EN- HANCE LUNG-TERM VALUE OF RIPARIAN LAND THEN REVERSAL OF MATER QUALITY DECEMBATION.	MINIMUM INPACT	MINIMUM IMPACT		PRESENTES AND MAY ULTHATELY EN- HANCE LONG-TERM VALUE OF RIPARIAN LAND THRU REVERSAL OF WATER OHALITY DESMANTION.	MINIMON IMPACT	MINIMIN IMPACT	MINIMUM IMPACT	MINIMIN IMPACT
LAME APPLICATION PROTESS OF ALCOHOLD BE PRESENTED BY DISTRICTORS. JOST EXCRETES OF PORTS ARABGEDERS TO GRAFING WITH ANY ONE LAND APPLICATION STREET, AND APPLICATION STREE	RECLAMATION OF RESOURCES	MINIMIN IMPACT	PROVIDES TREATED WASTEWATER FOR THE VALUE DUT TO MASTEMATER AND SLUDGE AP	PRICATION OF 92,000 ACRES, FERTILLER PLICATION OF \$1,420,000 FER YEAR.		MINIMUM IMPACT	MINIMIN INFACT	MINIMIN INDACT	MINIMIN IMPACT	MINIMIN IMPALT
	INSTITUTIONAL	LAND APPLICATION FORTION COUNTY OF POWERS ARM POSSIELLITIES. ONLY ONE INSTITUTE.	ILD BE INPLEMENTED BY EXISTING OR SILGHT ANGERENT OR CREATION OF A NEW ANSTERNIED FILLUTIONAL AGENCY SHOULD CONTROL ANY ONE	LY MODIFIED INSTITUTIONS. I MANAGEMENT ABBROW ABB. LAND APPLICATION SUB-		MINIMEN IMPACT	IN GENERAL, STATE STATI	UTES ARE ADSQUATE TO ALD DETION.	IN GENERAL, REDERAL STATUT INPUENENTING LAND PORTION.	TS ARE ADEQUATE TO ALD IN

¹⁾ THE POLICIES, ASSEMPTIONS WERE MORE IN APPRETINSTING WAS 12.5 PRODUCE.

1. ODGS SAMENE FOR FIRST COST LAND AMERITATION) WAS 12.5 PRODUCE STATE OF CALIFORNIA AND 35 PRODUCE PROBAL.

1. MERICANSET AND OPERATION AND PAINTEMBER OFFER WIRE CHRISTISMS IN BE LOCAL REPORTED.

^{2/} VALUES ARE INCREMENTAL TO THE BASE CONDITION.

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		NARA NAR	SAN FRANCISCO BAY-DELA	TA BEGION	BEGION	11/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1	10 1/1/1		01111
IMPACT	CENEBAI	OITE DO	CITE POPILI ATION	NOIDAN A	1	CAL	TOTAL		SIAIES
PARAMETERS	-	FAF	SETTLEMENTS	LINE POPULATION	GROUPS	GENERAL	GROUPS	GENERAL POPULATION	GROUPS
CHEMICAL/PRYSICAL FACTORS			SELONT WEREAST IN 1.0.5, OF LOUGH STREAMS, PRISSERE INCERSE! INCERSE! IN 1.0.5, OF ROUGHANTERS, CHANGE IN LAND USE AND CAOPTING PATTERNS IN LAND AREAS AND PLACEMENT OF ROPERS ZONES.	REQUIRES ABOUT 490 MILES OF PIPE- LINE. SHORT-TEM DISRUPTION OF PRESICAL PLATORES DUE TO CONSTRUC- TION.	METS WATER QUALITY PLANSING DELECT- TYES OF RESCONAL PLANSING ACCRESS ASSISTS IN INSURING OPEN SPACE PRESENTES.	AMETS THE ISTEM AND THE STATE AND SECURE STATE AND SECURE STATE AND SECURE STATES AN	MERTS THE ISTEAT AND TIME PRACTICE COLLECTOR STATE ACTES REACHES CONTROL NORMAL	MARTE THE LATEST AN	MORTS THE INTENT AND THE PRASING GOALS OF FURLICIAN 92-500.
ROTLOGICAL.	ESTORY, HENCE ENGALITY IN THE ESTORY, HENCE ENGANCE THE VLAMILITY OF THE RELICK'S ESTORICES FISH ARD WILLIEFE RESOURCES. ALTONS MATERIAL RELICEMENTION OF WATERWAYS.		DETECTION TO SERVICE SALE TO SERVICE SALE SALE SALE SALE SALE SALE SALE SAL	TEMPORARY INCREASE IN NOISE AND DIST DURING CONSTRUCTION WITHING ASSOCIATED BETWEETS ON WITHING THE	FROVIDES MAZIN AND RESOURCE AS- CYCLING. PROMOTES WILDLIPS MANGEMENT.	CONTRIBUTES TO THE POLIZITION MATERS OF CAL	CONTRIBUTES TO OFFERAL CAAL OF ACTULING HER POLLITION OF THE ESLAND AND DUCKAN WATERS OF CALIFORNIA.	CONTRIBUTES TO THE SALES SPECIAL SPECI	OWTHERTS TO THE MAINTAGE OF BATICALL MATERIAL SPECIES. CONTRIBUTES TO MATERIAL ENTRINSPECIES, CONTRIBUTED TO MATERIAL
AESTHETIC	EMBANCES THE ESTUARY BY REDUCING THE POTENTIAL FOR ALGAL BLOCHS. RILINAATES INSTRUCTLY SERAGE OUT- FALL PLANES. INSTRUS OPEN SPACE GREEN AREAS.		NSINES ORIN SEACH CARRY AREAS; INCREASES FLAS IN LICAL STRAME. PRESCREAKES MAT. IN SOR MINIS, INFRANCE DAYS MATERIA, ABSTRITTE VALUES.	INCREASED CONSTRUCTION ACTIVITY, PATHATIAL FOR DEVELOPMENT OF CREEK BELLS. PROSERLE REDUCTION IN SCENIC VALUES.	INSURES OPEN SPACE CREEK AREAS, INCREASES FLOW IN LICEAL STREAMS.	COMPATIBLE WITH NATIONALY PLAN BISHAY PLAN	OMBATIRA, WITH CALIPORNIA PROTECTED MATERIAL PLAN, AND CALIFORNIA SCHIC RESEAV PLAN,	MINIM	MINIMUM IMPACT
RECREATION	MERGASS ANTER CONTACT STORT OF POTENTIAL STORT OF POTENTIAL DESCRIPTOR. STORT		NOSSELLE TECHNOS IN PELANO CAMP HINTEN, NAS SPORT FESHENC POTESTIAL.	POTENTIAL TUR MALKING AND BACTULING PATHS, AND MINI-PARKS.	DECEMBER OF EXISTING AND NEWLY DEFENDED WATER TAKED RECENTION	DERENE IN YORK.	INCREAGE IN TOTAL MUNICIPAL OPPORTUNITIES.	LASSEARE IN TOTAL.	DERMOS IN TOTAL RETREATION OFFORTBRILLIS
USE OF NATURAL RESOURCES		97,000 ALRES FOR MAST 48,250 ALRES FOR SLUD 2,150 ACRES FOR LAND 9,800 ACRES FOR LAND	97,000 ACRES FOR MATERATIR APPLICATIONS 88,250 ACRES FOR LAND TRAPERS FACILITIES 9,800 ACRES FOR MATERATES STORAGE HALLITIES	MINIMIN INPALE	MENINE TRANSP	TINEN MEAN	MINIMIN INDUCT	MINIMIN IMPACT	803 TONS/DAY OF TREATMENT CHEMICALS, 11, 339 MICANATT MOURS/DAY OF POWER, 18,900 CHEMICAN OF NATIONAL
Min united with	SYSTEM ONLY PARKYMALLY WILD TO PROCEED TO THE CONTROL OF THE CONTROL OF THE CONTROL ONLY AND	13 ACC ACCES OF COOP CLASSES TROOM SECUL TO NA ACCESSOR AND ACCESSOR TO SECUL AND ACCESSOR TO SECUL ACCESSOR TO SECULTAR TO SECUL ACCESSOR TO SECULTAR TO SECUL ACCESSOR TO SECULTAR TO SE	TOTAL PRIVALENCE OF P. 4.20 IN TERM SETTLEMENTS, 1,010 DAS TOTALIAL AND 1,8 AD THE TERM AND THE TERM OF THE TERM OF THE TERM AND THE TERM	HERAT BANICALA TRANSTINNA, WITH SPEED PATENTAL SINSHIES ROOM, 1038, 1081AD GONSTREET OF ALLORROY URBAN GONSTREET OF PAGES DUE TO BENEVISHER OF COMMITTO OBJECTOR BENEVISHER OF COMMITTO OBJECTOR FARSA AND TRANSFELL WISSISSE HERAS AND TRANSFELL WISSISSE HERAS ORDERS STALL WISSISSE	20,000 ACRES OF THE CROP CHARGES AGILD PARTICIDARY APPEIRT THE DOORSELS AND PREMISTRE OF PRINCESSES, AND PREMISTRE OF THE CHARGES OF THE PRINCESSES OF THE PRINCESSES.	MANNE DRACE	PUTRIEL ALTEGIES OF SERIES OF SERIES ORANGE OF SERIES IN SERIES OF	LIVERY MINISTER	PRETECTION OF SERVICES OF SERV
PUBLIC ATTRUCES	CONCERN OF STSTEM SPECIT TO POSITION TRANSFER PROGRAMS SOME EMPHASSION OF AGRICULTURAL BENETIES THAN OFFICIALS AND TRANSFER SAME SOMETIMENS. SAME AND SAME AGRICITIES.	CONCERN OF SYSTEM TO PORT STREET, AND TOWNER, AS WITHOUT AND STREET, AND TOWNER, AS WITHOUT AS WITHOUT AS WITHOUT AS WITHOUT AND ADDRESS. AND THE SECONDARY OF STREET, AND THE SECONDARY OF ST	CONCERS OF SYSTEM TO STREE ALTER- ALTON OF REALL, LINES,FITE, AS WELL, as JOH AND REALLED OF SYSTEM FORTHAL WILLSAME AND ADDRESS FURLE HEALTH REPUESS.	INCONDITIONS OF PATRONS, SERVICE BERSON, MAINTENANT ALRONNY MAINTENANT, MAY TO ARCESS DIS- METION, DEK, AND WORK MERCAN CONTRACTION PRASE.	MATERY UPTR LOSS OF SOCKET STRUC- THE AND CHRISTICA AND SOCKET STRUC- GROWN PROPERTY AND STRUCK AND STRUCK SUSPERIOR STRUCK AND STRUCK SOCKET SUSPERIOR STRUCK STRUCK STRUCK SUSPERIOR SUSPERITION PAGES CONTENT OF TORSTELL SWILLIAM THE STRUCK SUSPERIOR SWILLIAM THE STRUCK SWILLIAM THE SWILLIAM THE SWILLIAM THE SWILLIAM THE SWILLIAM THE SWILLIAM THE SWILLIAM THE SWILLIAM THE SWILLIAM THE SWILL	OPPOSITION FROM MANITERS COOKEY VEYERSTS, TO FEE CONCERT OF STREAM MASS. TRANSPORT OF TREATED ANOTH- ANYES.	CONCESS OF HURANY SCRUES OF NATIONAL TO CONCESS OF NATIONS OF THE NATIONAL STREET, NATIONS OF THE NATIONAL SCRUENCES.	STATES INC.	CONTRACT WESTERN OF WESTERN WESTERN OF STREET, ON STREE
DISTRIBUTIVE EQUITY (CONSTRUCTION, OPERATION & MAINTENANCE WAGES)		PUTRYTAL OF 28 NILLION NON BAYS OF STAND MAGES SEQUENCES 51, 601 NILLION NEW STAND SECURITY SAMES OF CANST PUTRYLLOS NON HONELTY SAMES OF CANST NUMBER OF SAMES WOLLD BE TILL SAMES WOLLD BE TILL SAMES WOLLD SAME	PETRYLIA, OF 28 MILLION NAME OF WEST WEEDS TON SYSTEM CONSTRUCTION. STREE MAGES THE STREET, SHE STREET, SEES WILLION FOR MILLION FOR MILLION FOR MILLION FOR MILLION FOR MISSELTY SHARE OF CONSTRUCTION, STREET, AND STREET PRINCE OF CONSTRUCTION, STREET, AND STREET PRINCESSES, STREET, SHE SHELLOW, STREET, ONLY MILLION, STREET, SHE WELLOW, STREET, SHE WILLIAM, ONLY MALES WOLLD BY SHILLIAM, SHE WELLOW, STREET, SHE WILLIAM,		CONTRACTOR AND CONTRACTOR MONTHATTOR TARGET AND THE BAR MONTHATTOR THE CONTRACTOR TO CONTRACTOR TO CONTRACTOR THE CONTRACTOR T	DEFECTAL TWINSHIPS OF SOME SOMEOTIME SEASES, SENECHALLY TO POTESTIAL SOURTHWAY SHARE OF STRUCTION AND SOME OF SUITS OF STRUCTION AND ONE.	ORGENITION MODINS, ONSTRUCTION OFFICE ACCOUNTS, WITHOUT ACCOUNTS, WITHOUT ACCOUNTS, WITHOUT ACCOUNTS A	MUNIMEN DRIVET	MATOLIA MANIFACTURES, AND TRANSPORTATION INSUPER- PRESENT DISCRIPTION OF PRESENT GAMES OF
PUBLIC REALTH	HER ALTERATURE AURITRE UNIANA MASTEWATER A 4 CONTACT PET TOUT THE STOCKED PET TOUT THE STOCKED WITHOUT THE STOCKED WITHOUT THE STOCKED THE STOCKED TO THE STOCKED	THE ATTOMOSTIVE WILL INCREASE ATTOMOST OF THE THE THE ATTOMOSTIVE WILLIAMS: ANDIAL HUBERLIATIONS, AND THE POLYTICAL THE POLYTICAL WILL DON'THOSE OF THE ATTOMOSTIVE WILLIAMS OF THE ATTOMOSTIVE WILLIAMS OF THE ATTOMOSTIVE WILLIAMS OF THE ATTOMOSTIVE WILLIAMS.	ONE AND VERTERALT NOTAKEE FOLSTIAL FOR ZONSTIC STEASE FUR GREATER CONTROL OF ASSIGNMENT.	HINES HEAT	THE ACTEMATY WILL ENGAGE THE COMMENCE AND COMMENCE AS SHELL THERES. IN ESTUARING AND OCCAN MATERS.	MATIS THE APPROPRIATE MEGIANTIONS	OF SECTION AND ENGLIPTIONS. PROGRAMMS. OF CALIFORNIA STATE HEALTH ASSECTED.		MATES THE APPROPRIATE RESCIPTIONS OF PRINCIP SCALES AGENCIES.
FROLECT COSTS (\$1000)	\$ 22,000 280,000 90,000 5035 \$ \$32,000	PORTIONS OF THE CENSE COSTS MONTA & ROBIN OWNERS EQUITALISM COSTS FIRE INSTALLISM CONDENTIONAL INSTALLISM	MUSTAGN: INDIACT	HINDER DEPACT	NINIHEM IMPACT	CAPITAL COST AMORTE: S	5360,0003	SAPITAL COST SMBILL. SL	0.000
AGRICULTURAL PRODUCTION		RESTRICTED TO CROMING ONLY MICH NI ARE NOT BATCH NAW, MASTEMITES & DI PARMENS PROPERTY, WILL ME COMPANSA FOR ANY INCOMPENSARY OF LOSSES	NO ONLY HIGH NITROLIN UNIVERSALY, AND CROPS SHICH AND STREAMED AND AND AND STREAM OF THE STREAM ON A STREAM OF THE ACRE FOR YEAR OF COMPANY TO BE ACRE FOR YEAR AT OR LOSSES.	MINIMIM IMPACT	STICKER DRACE	MINIMA IMPACT	MINIMIN TREAT	AVERAGE ANNUAL ACRECULTURAL SACRE LOSS SATI, DOC. 18- COME GAIN AT YEAR 2000 OF	NINIMON INPACT
PUBLIC FINANCE	TAX LOSS FOR PURCHASED LANDS \$165,000.	KENTHUN IMPACT	MINISTER IMPACT	MINIMIM IMPACT	KINIMIN IMPAUL	MINIMUM IMPACT	HINDER DRAFT	AAAD, 0005. MINIMON IMPACT	MINIMIN IMPACT
LAND VALUES	PRESENTES AND MAY ULTIMATELY EN- BANEL LIME-TERM VALUE OF RIPARIAN LAND THEU REVERSAL OF MATER OUALITY DECRAMATION.	MINIMIN INFATE	MINIMEN INPACT	MINIMEN DRACE	PRESERVES AND MAY ULITHATELY SN- HANCE LONG- ERM VALUE OF RIFARIAN LAND THE REVERSERAL OF MATER OURLITY DECEMBATION	MINIMON IMPACT	MINIMUM IMPACT	MINDAM INDAM	MINIMEN INPACT
RECLAMATION OF RESOURCES	MINIMUM IMPACT	PROVIDES TREATED WASTEWATER FOR THE VALUE DOL TO WASTEWATER AND SLUDGE AP	RRIGATION OF 97,000 ACRES. FERTILIZER PELICATION OF 51,420,000 PER YEAR.	MINIMUM IMPACT	MINIMUM IMPACT	MINIMUM INPACT	MINISH IMPACT	SINISH DRACE	MINIMON EMPACE
INSTITUTIONAL	LAND APPLICATION PORTION COUL JOINT EXERCISE OF POWERS AREA POSSIBILITIES. ONLY ONE INST	LD BE EMPLEMENTED BY EXISTENCE ON SLIGHT ANGEMENT OF CHEATION OF A NEW WASTEWATE ITUTIONAL AGENCY SHOULD CONTROL ANY ON	AME APPLICATION PROCESS COLUMN TO PRESENTE ON SELECTE MODITUD INSTITUTIONS. DIET EXEMPLE OF POWERS ARRANGEDED ON CALLET ON PARTICULES ARRANGE ALREADY ALL FASSIBLETTES. ONLY ONE PRESENTATIONAL MENON SHOULD CONTROL ANY ONE LAND APPLICATION RIS-	HINDRING WINING	MINIMON IMPACT	IN CENERAL, STATE STATE IN IMPERMENTING LANGER	IN CENERAL, STATE STATUTES ARE ADEQUATE TO ALD IN IMPLEMENTAL SAND POSITION.	18 GENERAL, FEDERAL STATITES ARE ADEQUATE TO AIB EMPEROR TO AIB	TES ARE ADSQUATE TO AID IN

1/2 THE ROLLWING ASSEMPTIONS WERE MUDE IN APPRITORING PROJECT COSTS.

- COST SMALNS FOR FIRST COST (AND CARTIZATION) WAS 12.5 PRODEST LOCAL,

1.5 PROJECT STATE OF CALLIPORNIA AND 35 PRODEST FORMAL.

- MITCHESTER AND OFFENTION AND MAINTENANCE COSTS WERE CONSIDERED TO BE LOCAL
MAINTAINT.

2/ VALUES ARE INCREMENTAL TO THE BASE CONDITION.

		SUMMARY	SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE D-	CTS PROD	UCED BY	ALTERN	17VE D-1		
MPACT		SAN FRAN	CISCO BAY - DEL	A REGION		CALIF	ORNIA	UNITED	STATES
E.	GENERAL	SITE PO FARNERS	SITE POPULATION	CONVEYANCE	INTEREST	GENERAL PCPULATION	INTEREST	GENERAL POPULATION	GREHEST
ENTRINSMENTAL QUALITY CHESTICAL/PHYSICAL FACTORS	PROVIDES BEST PRACTICABLE TRAINERS TECHNOLOGY IN PROJECT YAR 2000. NINETY-ELGH PEGCENT RESOURL OF PRESPINARIS, ALTROGES AND B. 0.0.		H. OHT INCRESS IN T.D.S. OF LOCAL STRANG. POSSIBLE INNERASE IN T.D.S. OF GOODBOATES. GAMELI IS TAKE USE MAN CRAPPER ENTERS IN LANS ASSESSMENT OF BRIFTING INCRESS.	NUMBER ABOUT AND WILLS OF PITE- LINE, SACHT-THEN DISBURTION OF PRESIDENT FOR OF STREET ON OF STREETING.	SERIES MATER OF REGIMES PLANSING ONLINE PROPERTY OF REGIMES, ASSETTED, ASSETTED ASSETTING OFFICE STATES OF	MARTH ING DELICATAN	MATERIAL STATE AND TANK PARTIES STALLS	WELLS THE SKEBIT AND OF PUBLIC LAW 91-300.	THE PRANCES STALS
BOURORIGAE	RESTRAY, MATER GRALITY IN THE SETLARY, MANUE REMANCES THE VIABILI- ITY OF THE MATION'S ESTIMATOR THEN AND WILLIAM RESOURCES, ALLOWS NATURAL RELIYERATION OF WATERWAYS.		DOTATIAL INDIADENTO OF BARTIAL FOR DESIGNATION WAS STATE. **A OF SOLID, SAME STATES. INSURES OFFIS SHAPE **A STATE AND NEW STATES SOURCES. **CHE AND NEW STATES SOURCES.	TRIPOMARY INCREASE IN NOTSE AND INST DERING OMSTRUCTION SITIE ASSOCIATED EFFICES ON MILDIUPE.	PROFILES ANTER AND ESSENCE ROPOLING PROMOTES WILDLING WANALESENT,	CANTACHTES TO OVERA POLLETIAN OF THE EN-	ORTHERS IN OTHER SON IN VEHICLE DR PELETTE OF THE PASSE AND OTHER OF CALTURES.	CONTRIBUTE TO THE MATERIARMS OF WALLOW, MATERIARY, SPECIFIC, CONTRIBUTE TO WALLOW, MOTHERWAY, CLAIM, CHAIN	CENARCI OF NATIONAL STRUCTES TO NATIONAL
ARSTRETIC	CHANCES THE ESTUARY BY REDGING TO POTENTIAL FOR ALLAL RICKNES. ELIMINATES ENSIGNITY SEARCE OUT- FALL PLEMES. INSURES OFEN SPACE GREEN ARES.		NASHES OFFIX SPACE CREEK AREAS: INCREASES FUNE IN IDEAL STREAMS. BENEVINDAMENTS MAY IN SOME MINES, INCREASES AND MAJES.	INCREASED CONSTRUCTION ACTIVITY. PUTDSTEAL FOR SAVELORMENT OF CREIN RELTS. POSSIME REDUCTION IN SCHILL VALUES.	INCREASES OF SE SPACE CRIESS AREAS. INCREASES FLOW IN LOCAL STREAMS.	COMPATIBLE ALTRE CALIFORNIA S	OMPATHAE NITH CALTRIBOIA PHRECTO WATHERAYS PLAN AND CALIFORNIA STREET ALBERT FLAN.	KINDER	KINDEN DEDICE
MUNEATION.	INCREASE STITE CONTROL SYMP OPPERTURE STEELS IN THE ESTIMAT. POTENTIAL INCREASE IN SOURCES STORET TESTER AND MARKE FORL BEACH. POTENTIAL. INCREASED POTENTIAL PIN PASSIVE STORTS SCHOL SIGH AND THE TRANSPERTURE STORT SCHOL		POSSERIA ENCRARASE EN UTANDE GARM HENTENG AND SPORT PESSERIAS POTENTIAL.	POTENTIAL FOR MALING AND BLOYCLING PATHS, AND MINI-PARKS.	INCREASED RIS OF ELISTING AND SPECIFICATION ACTOR BACED RECKLATION AREAS	DESTANCE IN TOTAL SECRECTION OF	ORBATION REPORTSTITLES.	AD MOLEGISCON, PEAUL REPRESENT	REALTON OPPORTUNITIES.
USE OF NATURAL RESOURCES	TOWN MINIM	148, 30 4.7ES FOR 4AS 47,888 ACRES FOR LAN 2,884 ACRES FOR LAN 14,331 ACRES FOR AAS	44,100 ACRES FOR MATERIALES APLICATION: 10,1886 ACRES FOR MATERIOR APLICATION: 15,586 ACRES FOR LAND TRANSFER TRULLITIES; 14,331 ACRES FOR MATERIALES STORAGE FACILITIES.	SENERGY DREACT.	MINIMIN INDACE	SIKININA SIKININA	STRINGS INDUCT	MINIBON DRIVET	This took/har of treathers: CHENICALS, 13, 100 MICANATT BOURSTAN OF BORNE, 20, 550 CHEL PEET DAY OF NATHAN 21, AS ARE REDURED.
MIN-TEN-TEN-TO-	SYSTEM ONLD POTESTIALLY HELP TO INCLUDENT CHARLES SER AND INCLUDENT CHARLES TO CHARLES T	SALTE ACRES OF CHR CHACKES WILLD RESELT, IN SET AFRAGA ANNUA, INCHESTORMER, INCHESTORM	SE SETTIONNESS, AND POTENTIAL AND SETTIONNESS, AND POTENTIAL AND SETTIONNESS. AND POTENTIAL AND SET OF PROPERTY RESIDENCES, AND POTENTIAL AND SET OF PROPERTY RESIDENCES, AND POTENTIAL RESIDENCES, AND POTENTIAL RESIDENCES, AND POTENTIAL AND	PIPACT MATGALY TRANSTORY, WITH SOME PURSESS, ROOME ALGORITHM RESISTED TO A LACK TO A L	H, 300 AZES OF THE CROY CRAWES STORMER AND STREET THE STORMER CAS DEPOSITE CHARGETER STORMER CAS DEPOSITE CHARGETER STORMER CAS DEPOSITE CAS DEPOSITE	MINITED TREACT	PUTENTIAL ASTRACTOR OF MONOR REMAND FOR STRACE LAND SORE OF EASTER TO THE TOTAL OF THE TOTAL SORE FOR THE TOTAL OF T	CONTRACT SERVICES	PRINCELA ALTBACIN OF LANSK, SPOOD TE MICHAEL LANSK,
PUBLIC ATTIMBRS	OONGER OF STEEL FOR POSSIAN OF STEEL TO POSSIAN OF STEEL ENGINEERS PRANTATION OF STEEL S	TOWERS OF SISTEM TO FORCE STOKET. NOT INCOME. AS WELL AS HOUSED OF SISTEMATION. POTROTICAL SITEMATICANIC SISTEMATICANIC SISTE	CONCERN OF SYSTEM TO FORCE ALTER- ALTER OF STRULL LESSTIFFE, AS SOLI ACTORISTAL NUTSBACK AND ADVERSE FUNCTO HEALTH REFERSE.	DOGGONIECT OF PATRONS, STRICT, LATRO, AND IMPOSATE ALLOMOSTY SETTING, DEET, NOW NOTH BATTON, DEET, NOW NOTH DESIGN ON STREET, NOW NOTH	MATERIA PORTICIOS O SOCIAL, STRUC- TERRA AND COMBESTIONALLY SOCIAL AMERICANO. COMORNO OF MAYERSA AND SERVICES STRAINED SORRE AND SERVICES STRAINED SORRE SORRE AND SERVICES STRAINED OF PRESTORY CASES DISCOURTED OF THE SORRE SORRE SORRE STRAINED STRAINED SORRE	MANNEY DRIACT	OWELDS IN HOUSE SOUTH OFFE ACTORITIES, AN INDAM ACTO- ACTOR FOR IN CHARGE.	F18 (FI) 100 A13	CHROTON OF MICHAEL WORKERS ALTERATIONS DOWN IN CHOP GRANGES.
DISTRIBUTION ENGINE (CONSTRUCTION, OFBAJION & MARTENANE WACE)			MORTHAL OF M. HILDS NO ANY OR SME NAMED TO A STEEL STANDARD TO A STANDARD THE ANY OF THE STANDARD AND A STANDARD TO A STANDARD AND A STA		CONTRICTOR WINDOWS, DOUBLESTOR OF THE STATE	DRIAL PRICATION OF SOME CONTINUES AND CONT	CONTRACTOR AND TO SERVICE AND TO SER	179/JRT MBITMEN	MATERIA, MANTHACTURES (82) MATERIAL PROPERTY (8) SHARE OF SYSTEM CHOSTACTION,
MARTIC SERVICES			HES ALTERNATION WILL INCRACE ARTHOUSE WIN VESTIGATED SEASON MANUAL CONTRACTION. AND PRESENT OF MANUAL PROPERTY OF TAXABLES IN THE PRESENT SEASON FOR TAXABLE OF TAXABLES IN THE PRESENT SEASON. TO SEASON TAXABLES IN THE PRESENT SEASON.	NINEMBY PRINCE	THIS ALTERNATIVE WILL SHANCE THE CAPPURIOR, SHELLFISHING JABUSTEY IN ESTUARISE AND OCEAN PATERS.	MEETS THE APPROPRIATE REQUIATIONS	MENY THE APPROPRIATE REGULATIONS OF CALIFORNIA SELECT MEALTS ACROLLES		WEER HE APPROPRIATE RESTACTORS OF PERSON.
FRUIRCT COSTS (\$1000)	GATTAL COST \$22,000 \$375,000 ANDRIT. \$22,000 SAFEL. \$21,000 KRFL. \$26,000 TOTAL A. A. COST \$281,000	CRTION OSTS V WNERS OSTS F ONVERT	HINIMIN INPACT	MINIMUM ENTACT	MINIMUM INFACT	CARITAL COST AMORȚIZ \$2 TVIAL A. 60.081	\$22,000 \$ 22,000 \$ 22,000	CAPITAL COST S134,000 TOTAL A. COST	83,230,000 000 8 134,000
ACRICULTURAL PRODUCTION		RESTRICTED TO GROWING DRIFT BY CROSS WAS ATTENDED BY STATES WAS ATTENDED ON FATTER ON AVERAGE SAG PER PERSONAL ON LOSSES.	MATSURCHO DE GRANDO ONLY HERA STRONGS VEINO, CARDS, AND CROSS SHELDS ARE NOT RATES HAVE, ASSTERATES & DEALE, APPLICA- ALTON SYSTEM INSTALLED ON SARRIES FROM STELL HE COM- FRENCHED ON VIRGINE SAU PER ACRE PER YEAR FOR ANY DOING.	MINIMIN INDACT	MINIMIN INPACT	MINIMUNINDACT	TIMIKI HIKININ	AVESACE ANNIAL AGRICULTURAL INCOME LOSS SERA, ODG. INCOME GAIN AT YEAR 2000 OF SEAL, ODG	MINIMIN IMPAUL
PUBLIC FINANCE	TAX LOSS FOR PUNCHASED LANDS \$287,090.	MINIMUM DIFACT	MINIMEN EMPACE	MINIMUM IMPACT	MINIMON IMPACT	MINIMIN INDACT	MINIMUM IMPACT	MINIMON IMPACT	MINIMUM IMPACT
LAND VALUES	PRESERVES AND MAY ULIMATELY EN- HANCE LONG-TERM VALUE OF REPARAS LAND THRU REVERSAL OF WATER COLALITY DECRADATION.	MINIMEN ENGACT	MINIMUM THEACT	MINIMIN IMPACT	PRESERVES AND MAY DITEMPTELY ENHANCE LONG-TERM VALUE OF REPARLAN LAND THRU REVERSAL OF WATER QUALITY DEGRADATION.	MINIMIN IMPACT	HINIMIN IMPACT	MINIMON IMPACT	NINDEM DEFAUL
RECLAMATION OF RESOURCES	MINIMON EMPACE	PROVIDES TREATED MASTEMATER FOR PERTILIZES VALUE IN WANTEMAT BI. 400,000 TER TEAR.	THE LEMINATION OF LAW, DOD ACRES. OR AND SLIDGE AFFLICATION OF	MINIBON IMPACT	NINIMON IMPACT	MINIMIN IMPACT	MINIMUM IMPACT	MINIMUM DAPACT	MINIMIN IMPACT.
INSTITUTIONAL	LAND APPLICATION NEGLICIO DESTITUTO ORAZIONE NEGLICIO ONAL ONE INPITITUTI SUNNYSTEN.	LANG APPLICATION POSTUTO GOLD AS PROPEDENTED WE SELECTED ON ALLOHITON CONTROL AS PROPERED SOFT DESCRIPTION OF A NEW AND PROPERED APPLICATION OF A NEW AND PROPERED AS PROPERED AND APPLICATION OF A NEW AND ADDRESS AND APPLICATION OF A NEW AND APPLICATION OF A NEW AND APPLICATION OF A NEW AND APPLICATION AND APPLICATION AND APPLICATION OF A NEW AND APPLICATION APPLIC	O O STATIN	MUNIMENTAL	MINIMIN IMPACT	IN CEMENT, WATER VATUES ARE ADDUSTED ATD IN INCIDENCE. TO ALD IN	ANT ADDICIATE TO ALD IN	IN CENERAL, FERENCE STATES IMPLEMENTING LAND POSTION	IN GENERAL, FEDERAL STRITTS AND ARBOUTE TO AID IN PHILIPPENTING LAND POPTION.

If the feeders assertings and war is afvertisible project control.

 A. Out brains the interior (as avertialité) as 11.5 precess
 Forda, 12.5 preder error of california and 35 precess transace.
 R. Applications and precessing an advantage only with constitution.

In the local abstraction, to the base constitute.

		CHMANA	V OF MADA	OTC DEOL	WOLD DY	AITEDAI	ATILL D-9	0	
		SAN FRAN	SAN FRANCISCO RAY-DEITA REGION	TA REGION	0000	TL/L/I/V	TORNIA 7 1	CHLINITED	STATES
PARAMETERS	GENERAL	SITE	OPULATION	CONVEYANCE	INTEREST	GENERAL	INTEREST	GENERAL	INTEREST
	PUPULATION PROVIDES NO INCREASE IN THE	NAME AND ADDRESS OF THE PARTY O	TOTAL STREET STREET	LINE PUPULATION		PUPULATION	GROOPS	FOPULATION .	GHOOPS
CHEMICAL/PRYSICAL PACTORS	CHANTITY DE CHANTE DE CHAN	POSSIBLE INCREASE CRACE IN LASE USE LASE AREAS AND FLAC	FOSSER INSERTS IN 1.5.4. OF OROCINATED. CHART IN LARK USE AND CHAPTED IN PATENTIAL LAST AREAS AND FLACINESS OF SUPPLY STREET.	LINE SHORT-TIME DIRECTION OF FRENTCAL FEATURES BEE TO CONSTITUCE TIME.	PLANKING OKINCITORS OF WESTORS. PLANKING ACTORISES, ASSISTS IN INSURANCE OFFEN SPACE PRESERVES.	MEETS SHORT-RANGE (FIAL CONTROL BOARD,	MILES SHORT-RANGE CHALS OF STATE MATCH RESOURCES CONTROL BEARD.	FORLITAN 92-500, TRANSMERT PLAST COMPONENT DOES NOT. OVERAL, THE ALTERNATIVE MEETS P. 92-500 RECTEMBERS UNIT. 1983.	MEST PLAST ORNOWERT DOES ATTHE MESTS PL 93-900
EGILOGICAL.	STARLIZES POLITION ORIENTED BOUGOSICAL STRESS ON ESTRACINE FISH AND WILDLIFE RESOURCES. LIGITED SATURAL MELVERATION OF WATERAMYS.		POTRETAL THEOREMS OF MATCH FOR DELIGIAL SMALL MAN SPECIES. TRETAIN ONLY UNIT MANDETH, PROFESS. AND THE AND NO. 46 PM BOUNDS.	TORNIAM TOTAS IN RUSE AND REST AND REST AND REST ASSOCIATED STREET SAN STELLUTT.	FROTING WATER AND RESOURCE RECKLISH. FRONTES WILL LLD ANNACHUST.	CONTRIBCTES TO REDUCES MONDAT IN THE STATE.	ORBITATION TO REDUCTION TO CHARTEST WORKEN IN THE STATE.	CONTRIBUTED TO THE SAINT RETURN, CONTRIBUTED TO N DOALLY CONTR	CHARLES TO THE MAINING OF MATERIAL SATERFORD. BFRITE, CHRISTER TO RELIGIAL SEVENDESSER. BRAITY CHARL.
MESTMETTC	ENGANCES THE ESTUART BY REDICING THE PATENTIAL POR ALCAL MADONG. IN PRINCIPLY SPACES STRAIN DRIES AND ALCAL MADON.		INDINES OPEN DAGE GEEN ARMA, INCLUSES FLOW IN LOCAL STREAM). DEPOTORNEY NOT, IN SHIE NEWS, ANYWOL THAN METHOD ASSESSED.	INCREMENTS ONSTRUCTION ACTIVITY OF SHIRN SHILLS. FOR SHIRN SHILLS. FOR SHILLS. SHILLS. SHILLS. IN SECULOR IN	DOUBLESS OF STATE CREEK AND STATE OF STRUME.	COMPATIBLE ALTH CALL PLAN AND CALLEGERS	OBENZIAL MITH CAN RESULA PRINCIPE SATIKANI FLAM AND CULTURE RESULT SUBMAY PLAN.	DESCRIPTION DON'T	DPACT
SECRECTION	MORRISON ACTUR CONTACT STORY OF PROTECTION ACTOR OF THE STORY OF THE S		PONCEAL ENGINEE IN TELAND CAME MOSTING AND SPORT	POTENTIAL FOR VALCTOG AND SICYCLING FAINS, AND SIMI-SAMES.	INCREMENT USE OF EXISTING AND STORY SHAPES MATER SAMES AND RECEIVED AS THE SAME SAME SAME SAMES AND SAME SAME SAME SAME SAME SAME SAME SAME	TRESEANE IN YOTAL REG	SCHARL IN TOTAL BESTARTER STREETSTIFF.	TWOMBARK IN TOTAL RECEILETTON	8
USE OF NATURAL RESOURCES	MINIMIN INDACT	145,000 FOR WASTINE 14,805 ACRES FOR 5 2,885 ACRES FOR 1 14,311 ACRES FOR 9	AND THE WASHINGTH APPLICATION. AND ARREST OF THE APPLICATION. A SEA ACREST OF LAND TRANSMENT PARTITIES. B, 731 ACRES FOR ARRESTMENTER STORAGE PARTITIES.	NONDRIN DRACT	MINIMUM LMPAIN	HISTHON IMPACT	MINIMUM INGACT	MINIMIN INPACT	80 TOMSTRAN OF THEATHENT CHEMICALS BY BOOKE IN 550 SOURCE ON TO POSKE IN 550 CHEE PRESTOAN OF NATIONAL CAS ARE RESULTED.
MIN-THE PRINK	SYSTEM ONLY PRESCRIPTION WILL BY STATEMENT AND THE WAY SHARE PRESCRIPTION AND AND AND AND AND AND AND AND AND AN	54,720 AUSTS OF CAPP CRACKES AND REITH, FOR STAFFANGE AND AND SELLING STAFFANGE CRACKES OF TAXABLE FOR EXCEPT CHARGES. PUTDY LAG CHARGE REACHEST OF TAXABLE WOULD RESELT IN SET ACTOR TO SELLING STAFFANGE AND ALL WOULD GLIN OF \$1,122 FROMAND.	ACTUAL PRINCING OF \$1.00 DESTRUCTOR OF \$1.00 D	MAT AND TANK THAN THAN THAN THAN THAN THAN THAN THAN	NA, 600 ACRES OF THE CARP CHANCES RANGED RATERIALS A FUELT THE OF THE OF THE CARL THE CONNECT OF THE CARL THE CONNECT OF THE CARL	There is a second	POTESTIAL ALTEMATION OF STOKES ORANDO TOR SILVONE, LARCES, SOME CHARACTER, OF THOSE PROCESSING STOKES, OF STATISTICAL PRODUCTION DEPLOYERS, REPORTABLY PRODUCTION DEPLOYERS, REPORTABLY TO NORTEDBY TAKE OF STATE.	STREET FORCE	PUTENTIAL AUTOMATION OF WORKER DENNIN PRINCIPLOS OF LABOR.
PERLIG ATTITUDES	ONCING OF STRIPS FFFCT TO POSSIBLY INCLUDED STRINGS SOCIETARIS TO MANIFOLD OF STRIPS SOCIETARIA SOCIETARIA SOCIETARIA SOCIETARIA NO DOUTTOMAS IN SAN JONGTHA MODITARIA SOCIETARIA SOCIETARIA SOCIETARIA SOCIETARIA SOCIETARIA	CONCING OF STEELING TO ROSE STORM PETCHAT ALTERATION TO PARK OFFRACTION AND INCOME, AN WALL AS WINSHALT AND ANYONES FURSIC SHALTH GIFFELS.	CONCERS OF SYSTEM TO NORTH AUTHORITIES AND SHORT OF SYSTEM OF SYST		AN DITTOR LASS OF SCHLAL THE TRY AND ORNERS OF THE TRY AND ORNERS	TOWNERS WHICH THE	OWERS OF WICKAST MINERS OFF AGRICULTURAL ON DEAKO ALTRACTORS ONE IN COMP CASCORS.	TOWNER WINDOWS	CONCINS OF STORMS WHEEDS ASSESSED THE ARRUPTING DOES TO CHOR COUNTRY.
SCHEDULE RECES (CONSTRUCTOR PAGES) VALVERANCE PAGES)		POTESTIA, OF 20 WILLOW MAY DAYS OR MORE PRESENTED THE STREET STATE AND WASTE STREET, THE MILLIAN WAS STREET, THE STREET, THE WILLIAM WAS STREET, THE S	COURSTAL OF 26 WILLOW AND ARTS OR WORD WINDS FOR SYSTEM CONSTRUCTION, STOCK WAS INCLUDED SILVED BY BYTHAL SYSTEM, SILVED WINDS SHALLOW BY STATEM, SYSTEM SILVED WILLIAM SON STRUCTION STREET, AND SAN STATEM SILVED WE TAKEN WHILE ONE DEPLOTMENT OF SYSTEM IN PLACE WHILD WE 7,000 TO 9,000.		CONTRACT BY THE TOTAL CONTRACT BY CONTRACT BY THE TOTAL BY THE BY THE TOTAL BY THE BY THE TOTAL BY THE TOTAL BY THE BY T	OTSETIAL DEPLICATION OF SIDE CON- TRECTION MORRIES, ESPICIALLY POIN TRECTION MARKS OF TO TO OTSETIAL RESIDENCES WARE OF TRECTION AND OWN.	MONTHALTIS WASKED ASSTRAINED AND ANTERIOR ANTERI	MENTAGE INDIVIDUAL	MATRIAL MARRATURES AND MATRIAL MARRATURE STORY (MATRICE) IN SHARE OF STORY (MATRICE) SALES
PURITE BRACIN	THE ALTERATUS STACES UNAN HEATER AND A SCHOOL OF FOUND A SCHOOL OF FOUND AS A SCHOOL OF THE ESTIMATION IN THE ESTIMATION OF SCHOOL SCHOOL OF SCHOO	THIS ALTERATIVE WILL INCREASE ANT POPULATIONS, AND INCREASE THE POTE THE POTE THE POTE THE POTE TO STATE OF CHARLES CO. BEACHER. C. BACABOROS TO HEALTH.	THE ALTERATIVE WILL DOCKER ATTROPOS AND THTERSAUT WILLAMIT ANYMOPHICATIONS, AND TREATMENT OF THE POST OF THE VOTESTAL THE VOTESTAL STATES OF THE VOTESTAL STATES OF THE VOTESTAL STATES OF THE VOTESTAL STATES OF THE VOTESTA	MINIMON IMPACT	THIS ALTERNAPYE WILL ERBANG THE COMMENCE THE COMMENCEAL SHELFSHING TROUGHTY IN ESTUARINE AND OCCUM MATERS.	MEETS THE APPROPRIATE MEGILALI	REGILATIONS OF CALIFORNIA STATE BEALTH	MARIS THE APPROPRIATE REGULATED	APPOPRIATE RESEARCHES OF PEDISAL BEALTH ACROSES
HOUSEL 1/ 3/	CAPITAL COST \$20,000 5310,000 0681 185,000 8251, 24,000 0731 1 A FORT	POSTIONS OF THE GENERAL PURTLATION COSTS WOULD BE SORE BY LOCAL LANG GENERAL SOLEN TO THEIR NOBLAND COSTS POR INSTALLING AND OPERATING ONCOME.	PORTIONS OF THE GENERAL PARCIATION OSSESS REGULAR ENDERSON OF THEIR WORKER COSTS RETURNEST TO THEIR WORKER COSTS RETURNEST TO THEIR WORKER COSTS RETURNEST TO THEIR WORKER	HINIMIN LANGE.	MENTHUR TRUACT	CAPITAL COST ANORTIZ. ED TOTAL A. A. CRST	\$310,000 \$20,000 \$20,000	CAPITAL COST AMORITZ BL17,000 TOTAL A. A. COST	\$1,880,000
ACRICULTURAL PRODUCTION	SEE CENERAL POPULATION, UNITED STATES	RESECTED TO CRUSTO ONLY BIGGS ST NOT BAIDS RAW, VASTEWATER AND DRAI FOUREST WILL BE COMESSATTO ON ANY INCOMVENIENCE OF LOSSES.	TROOPN USING CROPS AND CROPS WHICH ARE IN APPLICATION SYSTEM INSTALLED ON PARKE ERAGE 540 PER ACRE PER YEAR FOR ANY	ME MINIMON IMPACT	MINIMUM IMPACT	WINDHI MENTA	MINIMUM DAPACT	AVERACE APPLAL ASSIGNATORAL INCORE LOSS \$117,000. INCORE GAIN AN YEAR 2000 DF \$644,000.	MINUMEN INPACT
PUBLIC PINANT	1AX LOSS FOR PURCHASED LANDS \$287,000.	MINIMUM IMPACT	HINEWEN THRACT	MINIMUM INDACT	MINIMEN THRACT	MINIMUM IMPACT	Deract	MINIMUM INDAME	DMACT
LAND VALUES	PRESERVES AND MAY ULTIMATELY EXHANCE LONG-TERM VALUE OF RIPARIAN LAND PHRU REVERSAL OF MATER QUALITY DEGRADATION		MINISTER DERGT	MINIMIN IMPACT	PRESERVES AND MAY ULTIMATELY ENHANCE LONG-TERM VALUE OF RIFARIAN LAND THRU REVERSAL OF MATER QUALITY DEGRADATION		MINIMUM INPACT	MINIMUM IMPACT	DAPACT
RECLAMATION OF RESOURCES	MINIMUM IMPACT		PROTIDES TERATED MACTERATOR FOR (MAIGATION OF 148,000 ACRES. PROTILEEN VALUE DE TO WASTEWAYER AND SLIDGE APPLICATION OF \$1,900 FOR YEAR.	MINIMOM IMPACT	MINIMON IMPACT	COMPAN COMMIN	PHPACT	TIMBUM INDUSTR	INFACT
INSTITUTIONAL	LAND APPLICATION FOR INSTITUTIONS, JOINT MASTEMATER ANAGERIEN SHOILD CONTROL ANY OF	LAND APPLICATION PORTION CONTO NE INVERSENTED NY COLSTING ON ELICETY MODIFIED STRITTINGS. GARDEN OF A NEW WASTERNIER MACAGEMENT ACCOUNTS AND POSITIONATION OF A NEW SACIEDATIES AND ACCOUNTS. ONLY ONE INSTITUTIONAL ACCOUNTS	G OR SLIGHTY MODPHED REATION OF A NEW E INSTITUTIONAL AGENCY	MINIMUM INPACT	MINIMIN IMPACT	IN GENERAL, STATE STATE EMPLEMENTING LAND FORTE	IS CENERAL, STATE STATITES AND ANDICATE TO ALD IN HELDERSTEIN LAND FORTION.	IN GENERAL, PEDERAL STATU IMPLEMENTING LAND PORTION	IS CHORRAL, PEDEMAI STATUTES ARE ADEQUATE TO AID IN IMPLEMENTING LADID PORTION.

1.3.5.5.6.

- 1) THE DOLLOUPER ASSUMPTIONS WERE NAME IN APPORTIONING PROJECT COSTS.

 A. COST SHARING FOR FIRST COST (AND APPORTIANTING) WAS 11.5 PERCENT LOCAL,

 11.5 PERCENT SALE OF CALLIDGES AND TO FRACEST PRIBAL.

 B. ELICALOUSTS AND CONTAINED AND MAINTANGEL COSTS WIRE CONSIDERED TO

 BE LOCAL MESPONSIBILITY.
- 2/ VALUES ARE INCREMENTAL TO THE SASE CONDITION.

		SAN FRANK	SAN FRANCISCO RAY-DEL-A	DEGIONI	COLD DI ALIMANIA DIO	7/1/1/1/1/1	7/1/7	7	CTTATO
MPACT	*		SITE POPULATION ERS SETTLEMENTS	CONVEYANCE NE POPULATION	INTEREST	GENERAL	INTEREST	GENERAL POPUL ATION	INTEREST
CHEMICAL/PHYSICAL FACTORS				ARGUIRES ABOUT 490 MILES OF FIFE- LINE. SHORT-TERM DISRUPTION OF PWESTCAL FEATURES DUE TO CONSTRUC- TION.	MESTS WATER COALITY PLANNING OBJECTIVES OF REGIONAL PLANNING ACENCIES. ASSISTS IN INSCRING OPEN SPACE PRISERVES.	MUSTIF THE INTEST AND TIME PHASING COALS THE STATE ANTER ESSURCES CONTROL SOME	TEME PRACING COALS OF UNITS CONTEST NAMED	METER THE ENTERT AND THE PLANCES SCALE OF PUBLIC LAW 92-900.	SO TIME PUASING # 92-930.
BODLOCICAL	EMPROVES WATER QUALITY IN THE SETTMEN, BROWNE THE VIA- MILLYT OF THE RECON'S ESTURATION FISH AND WITHIN RESOURCES. ALLOWS WATERAL RELEVENATION OF WATERMAS.		POURSTELL DEWENDERT OF RASILAT TOR DESEABLE SWALL WAS SPECIES. DARMES ON'S SPACE PRESENCES. WOURDS ADDITIONAL MOLESS OF WATER AND NEW MATER AND NEW MATER.	TEMPONARY INCREASE IN MOISE AND UGST DORING CONSTRUCTION WITH ASSOCIATED EFFECTS ON WILDLIFE.	PROVIDES MATER AND RESOURCE RE- CYCLING, PROMOTES WILDLIFE MANAGERENT,	CONTRIBUTES TO OVER THE POLLITION OF THE WATERS OF CALIFORNIA	CONTRIBUTES TO OUTSALL GALL DI REDUCISC THE POLITICISC OF THE BILLAND AND OCEAN SALESS OF CALIFORNIA.	CONTRIBCTES TO THE MA WATERDAL SPECIES. C ENTROPHENTAL BUALLY	CONTRIBUTES TO THE MAINTANES OF SATIONAL DESIGNMENTS TO MATIONAL DESIGNMENTS TO MATIONAL
AESTHETIC	ENMARGES THE ESTEMAY BY REDUCING THE PATENTIAL FOR ALGAL MACHES. ELIMINATES UNSIGHTLY SEMANE OUT-PAIL FLORES, INSURES OPEN SPACE CREEN AREAS.		INSTANCE OFFIX SPACE AND A TRACKERS FLOW IN LACAL STREAMS. INSTRUMENTS MAY IN AMERICAN INSTITUTE OFFI ANTHREE VALUES.	INCREATED CONSTRUCTION ACTIVITY, POTESTIAL FOR DEVELOPMENT OF GREEN BELLYS. POSSIBLE REDUCTION IN SCENIC VALUES.	INSIRES OPEN SPACE GREEN AREAS. INGREASES FLOW IN LOCAL STREAMS.	CAMPATIBLE WITH CALTURNIA PROTECTED WATERWAYS PLAS. HIGHWAY PLAS.	LINGRIA PROTECTED CALIFORNIA SCENIC	NORTHER N	MINIBON IMBACT
ROSEATION	DECRASSION MATERIAL OFFICE STORY OFFICE AND ANGEST OFFICE SELECTION OF		NUSSERRE INCREASE IN UPLAND CAME RESTING AND SPORT FISHING PUTESTIAL.	POTENTIAL POR WALKING AND SICYCL- ING PATHS, AND HINI-PARKS.	INCREASED USE OF EXISTING AND NIMEY DEFINIOUS MATER BASED RECKEATION AREAS.	INCERASE IN TOTAL REC	INCREASE IN TOTAL RECEIVATION OPPORTUNITIES.	INCREASE IN TOTAL BE	INCRESE IN TOTAL RECENTATION OPPORTUNITIES.
USE OF NATURAL RESOURCES	MINIMUM INDACT	148,000 ACRES FOR WA 42,200 ACRES FOR SL 3,000 ACRES FOR LA 14,900 ACRES FOR WA	144,000 ACRES FOR WASTEANER APPLICATION: 42,200 ACRES FOR LADOR APPLICATION: 52,000 ACRES FOR LADO TRANSMENT FACILITIES; 14,900 ACRES FOR WASTEANERS STORAGE FACILITIES.	HINDRIM IMPACT	MINIMUM IMPACT	HINIMH IMBACI	IMPACT.	MINIMUM IMPACT	540 TONS/DAY OF TREATMENT CHEMICALS: 15,650 MICANATT BOURS/DAY OF POWER: 20,550 CUBIC FREY DAY OF NATURAL CAS ARE REPORTED.
ASSA VLARILITY	SSSIDE COULD POTRETALLY HILP TO BEEN DONNELS OF STREET OF STREET AND ASSESS OF STREET HAT SHALL BE HALL BEEN WHILD BE SENTENCED AS OF STREET OF STREET HAT SHALL BE SHELL WITHOUT DE DESCRIPTION OF STREET OF STREET SHALL BEAUTIFUL SET OF STREET OF STREET OF STREET SHALL BEAUTIFUL SET OF STREET SHALL BEAUTIFUL SHALL SHA	NAME OF STATE OF STAT	THE THE PROCESS OF \$1.00 IN TEXTS OF THE PROCESS OF \$1.00 IN TEXTS OF THE PROCESS OF \$1.00 IN TEXTS OF THE PROCESS OF THE PROC	WHICH MATICALLY TRANSTERMY, WITH WE POTENTIAL DESIRESS TOOMER SET AT SECOND AS IN TRANSPORT OF THE WASHINGTON PROPERTY OF TOWARDS DESIRETION. POTENTIAL SEGMENT TO WARDS WITH THE WARDS AND THE SECOND AS AND THE SECOND TO THE SECOND TO THE SECOND TRANSPORT OF TRANSPORT OF THE SECOND TRANSPORT OF	NA,000 ACRES OF THE CROP CRASHS NULL MATITICALEM A PETER THE FOUNDATION AND AFFECT THE FOUNDATION AND AFFECT THE FOUNDATION A CHRASHING OF WASHING DEAGN FOR MIGHEST LORGE, MATI- GUARA VERNEASE LANGE, MATI- GUARA VERNEASE DE NO BANCHO RE- LACATION DESIDENCY DELIGIOUS MATINITAL OF STREET OF STREET MATINITAL OF STREET OF STREET OF STREET PRICEATION.	TOWNS MINISTER	PRINTED ALTERATION OF WORKER PROPORTING TARGET, INVESTIGATION OF THE PROPERTY	MINIMEN TREACT	NUBSTAL ALTEACTON OF WASTER DEWAND FOR HIGHAST
FUBLIC ATTITUDES	CONCERN OF STRIPS EPFELT TO PUSS- LIANT PRELIDENT ENCEAGED TRANS- LIANTING OF RESIDEN. SOME EDPHESSION OF AREJOLITHMA. BARRETTS FROM DOFFICIALS AND 13- BARRETTS FROM DOFFICIALS AND 13- BARRETTS FROM DOFFICIALS AND 13- NATA CHORTIES.	COMCERN OF STOTE TO PORT STORITY. NOT THE TOTAL AS HOSTORY ADDISTRY PORTER, MY HOSTORY ADDISTRY PREACT HEATER.	COMERN OF STRIPE TO THEIR SCOTTS - COMERN OF STRIPE TO PROCE ALITIN- NOT TREATING TO ANY OFFICE SCOTTS - AND AS AND AS ANY OFFICE, AND AS AND AS ANY OFFICE AND ASSESSED ANY OFFICE AND ASSESSED ANY OFFICE AND ASSESSED ASSESSED AND ASSESSED AND ASSESSED ASSESSED AND ASSESSED ASSESSED ASSESSED ASSESSED ASSESSED ASSESSED ASSESSED.	INDOVERTIBLE OF PATRONS, SEVICE TAXABLE AND INDOVERTIBLE ALLOSSY, OPEN ARCISS ROS- RETTIES, DRY, ONEY, AND WORSE GRATES, ORNAND TO SEVEN AND WORSE GRATES, ORNAND TO SEVEN AND WORSE	AMETY O'RE LOSS BOTCH, STRIC- TITER AND ORBEIGN ANNE SINE FINEL CHARGE, SORGEAU F SHAZISH- AMETICASI, CONCERN OF BILITIES AND SERVE ES STRICTURES SINE AND SERVE ES STRICTURE O'RE STRUCTURE PRAISE, COUCERS OF STRUCTURE PRAISE, COUCERS OF STRUCTURE SINE SERVENTION SERVENT O'RE POSSESSEE ENTREMENT OF SERVENTION SERVENT	NATIONAL TRANSPORT OF MASTERS.	CONCERN OF MICHAEL WHITES OVER AND COLITINAL JOS DENNO CHANGEL, NO CHOR CHANGEL, NO CHOR	TAGKI MMINIM	CONCEAN OF MICHAEL ON PERMISSION OF A AGENCY TRACE ON PERMISSION OF TO CROP CHARACTERS,
ASSELBATIVE AGELTY (CONSTRUCTION, OFBERTON &			DATE OF WARE NEEDED FOR WALLS LOCATION IN 18 AND A		AMENICATION SCALE CONTENTION AMENICATION STABLE ONTON, ANCED IN MARKINERS, TARREST INTENTION STORIES, AND STABLES AT THE INCLUSION STORIES AND STABLES	OT ESTIAL INCIDACTION OF SEME CON- TRACTION WHEREA, ISSUEDIALLY FROM THE SEMENTAL SIGNATURAL SHARE OF POTENTIAL SIGNATURAL SHARE ON ENVIRONMENTAL SIGNATURA FRICTION AND OBS.	CONTACTOR ACCOUNTS. ANTICLESS. TOUR DOINGS. ANTICLA. ANTICLESS. ANTICLA. ANTICLESS. ANTICLA. ANTICLESS. ANTICLA. ANTICLESS. ANTICLA. ANTICLESS. ANTICLA. ANTICLESS. ANTICLESS. ANTICLESS. ANTICLESS. ANTICLESS. ANTICLESS. ANTICLESS. ANTICLESS. ANTICL	LINEAU MANNIN	MATRIAL MANUFACTURES AN TRANSPORTED IN MARKE UP FYSITS CONSTRUCTION.
PUBLIC HEALTH	MATEMATER AS A SOURCE OF TOTAL MATEMATER OF THE STATEMAT MACHINE CONTROL TO WATERSONEN IN- DESCRIPTIONS. MATEMATER PARKET NY MATEMATER OF MATEMATE	THES ALTERNATIVE WILL INDEXACE ANTENDED AND VERTIBERTY NELSANG AND PREPRIATION, AND INSERTABLE THE INDEXACES THE OFFICE OFFICE AND INDEXACES THE POTENTIAL ENTER THE MACHINE CONTROL OF AMBICULTURAL CONTROL OF MACHINE INDEXACES.	AND INCREMENT AND VEHTERATE AND INCREMAN THE POTENTIAL SHIDE, THE POTENTIAL EXISTS ULTERAL CONTAMINANTS BAZARDOUS	MENTANIN INPACT	THIS ALTERNATIVE WILL ENGANCE THE COMPENCIAL SHILLFISHING INOSTRY IN ESTURBERS AND OCEAN WATERS,	MESTS THE APPROPRIATE REGULATIONS OF	THE APPROPRIATE REGUATIONS OF CALIFORNIA STATE HEALTH AUBILLES.	NESTS THE APPROPRIATE REGULATIONS OF PERBASA HEALTH ADDRESS.	EGLATIONS OF PERENAL
ECONOMIC 1/ 2/ PROJECT COSTS (\$1000)	CAPITAL COST \$14,000 \$410,000 ONE \$210,000 REFL \$231,000 REPL \$231,000 REPL \$250,000 \$305,000 REPL \$0.001 \$305,000	POSITIONS OF THE UNIXALA, PROFILATION CONSISTS MOTION IN SINKE THE LOCAL LAND- CONSISTS IN STATE AND THE NUMBER OF STATES OF S	HINIMON INPACT	HINIMON INFACT	NINIMOM INCACT	CARITAL CUST AMBRILZ. S24,000 TOTAL A. A. COST	\$ 34.000	CAPITAL COST AMMETE: 5143,000	25 .
AGRICULTURAL PRODUCTION	CENERAL POPULATI	RESTRICTED TO GROWING ONLY HIGH NIT PARE NIT EATEN KAW. MASTEWATER AND PARENCE PROPERTY WILL BE COMPENSATE FOR ANY IMMONEVALENCE OR LONGESS.	ROCEN USING CROPS AND CROPS WHICH DRAIN APPLICATION SYSTEM INSTALLED ON ID ON AUGUST \$40 PER ACRE PER YEAR	MINIMUM IMPACT	MENEMEN EMPACE	MINIMIN IMPACT		AVERACE ANNIAL ACRICULTURAL UNDER LOSS \$711,000, IN-	MINIMON IMPACT
PUBLIC FINANCE	TAX LOSS FOR PURCHASED LANDS \$287,000		MINIMUM IMPACT	MINIMIN INDACT	MINIMUM IMPACT	MINIMIN INFAUT		MINIMIM	IMPACT
LAND VALUES	PRESENTES AND MAY DITIMATELY EN- RANCE LONG-TEXEN VALUE OF RIPARIAN LAND THRU REVERSAL OF WATER OWALITY DECRADATION.	DKINIK	HINIMUM IMPACT	MINIDOM IMPACT	PRESERVES AND MAY ULTIMATELY EN- HANCE LONG-TERN VALUE OF RIPARIAN LAND THRU REVERSAL OF MATER	MINIMIN IMPACT	IMACI	KINIE	HINIMIN IMPACT
RECLAMATION OF RESOURCES	MINIMUM IMPACT	PROVIDES TREATED WASTERNA 148,000 ACRES. FRAILLIN AND SLUDGE APPLICATION OF	TER FOR THE ERRIGATION OF ER VALUE DUE TO MASTEMATER 11.850.000 PER YEAR.	MINIMON IMPACT	MINIMUM IMPACT	MINIMIN INPACT	THPACT	CIMINIM	MINIMUM IMPACT
INSTITUTIONAL	JAND APPLICATION PORTION COG JOINT EXECUSE OF PORTES ARR POSSIBILITIES. ONLY ONE INS SYSTEM.	A AND APPLICATION POPERTIS OCCUPA EL PERFORMANCIA DE RESENTAS ES SELECTE MODELLO DESTITATIONS. AND APPLICATION POPERTISATION OF A NEW ACCENTAGE WASHINGTON WASHINGTON OF A NEW ACCENTAGE WASHINGTON AND APPLICATION OF A NEW ACCENTAGE WASHINGTON AND APPLICATION OF ANY OWE LAND APPLICATION DESTINATION OF A NEW ACCENTAGE AND APPLICATION DESTINATION AND APPLICATION APPLICATION AND APPLICATION APPLICATION AND APPLICATION A	HILY MODIFIED INSTITUTIONS. IER MANAGEREN ACENCY ARE INE LAND AFFLICATION SUB-	MINIMUM IMPACT	MINIMUM IMPACT	IN GENERAL, STATE STATUTES ARE ADEQUATE TO AID IN IMPLEMENTING LAND PORTION.	ARE ADEQUATE TO AID IN	IN CENERAL, FEDERAL STATUT IMPLEMENTING LAND PORTION	IN CENERAL, FEDERAL STATUTES ARE ADEQUATE TO AID IN INCLEMENTING LAND PORTION.
Ā À	26	PRILOWING ASSEMPTION WIRE MADE IN APPRITORING PROJECT COSTS) ONTS SHOURS THEN PLANT COST LOSS AND AND THE TOWN INC. 11.5 PRILOWS THEN PLANT COST AND 35 PRICEST PRIBABLY. HER MCCHENT AND PERMITON AND MAINTENANCE CONTINUES THE CONSTITUENT TO THE UNCAS. HER MAINTENANCE TO THE MASE CONSTITUE.	r, 100at.						
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IATIVE B	-3			AL	TERNATIVE D	-3	
CN	CONVEYANCE LINE PCPULATION	INTEREST GROUPS	GENERAL	SITE POF FARMERS	OLATION SETTLEMENTS	CONVEYANCE	INTEREST GROUPS
LASE IN TDS OF GROUNDWATERS.	REQUIRES ABOUT 40 MILES OF PIPELINE. SHORT-TERM DISRUPTION OF PHYSICAL FEATURES DUT TO CONSTRUCTION.	WOULD PROFIDE A MEANS FOR LOCAL COM- PLIANCE WITH FEBREAL, STATE AND RESIDEMA. WATER QUALITY PLANKING OWINGTIVES, ASSISTS IN INSURING OWEN SPACE PRESERVES.	PROVIDES CAPACITY FOR LAND TREATMENT OF LOCAL MATES, SINGLY-LIGHT PERCENT KARWAL, OF PROSTRUCES, SITEMERS ARD NO FROM MASTERATER WOULD BE PUSSIBLE.	SELECT DOCACASE IN The OF LOCAL STRAME, POSSIBLE (SOCIACE IN THE OF CHOUNCE WITHER, CHANGE IN LAND FOR AND CHOPFING PATTERNS IN LAND AREAS AND PLACEMENT OF REPORTS,	POSSIBLE INCREASE IN TOS OF CROUNDS O PATTERNS IN LAND AREAL AND PLACEMENT	SEGUTES ABOUT TO MILES OF PIPELINE. SEGUT-TERM DISHIPTION OF PHYSICAL FRATURES DUE TO COMSTRUCTION.	WOLLD PRIVIDE A MEANS FOR LOCAL COM- PLIANCE WITH PEANSING ORBIGITIES. WHIRE COLLITY PLANNING ORBIGITIES. ASSISTS IN INSURING OPEN SPACE PRESERVES
	TEMPORARY INCREASE IN MOTHER AND DUST DURING CONSTRUCTION WITH ASSOCIATED EFFECTS ON WILDLIFE.	PROVIDES MATER AND RESOURCE RECYCLING. PROMOTES WILDLIFF MANAGEMENT.	POTENTIAL IMPROVES EXISTING AND PROVI	POTDETAL DEBOUERENT OF INSITAT FOR BESTAGEL BANLL GAGE SPECIES, DEBOUYE. EXISTING AND PROVIDES NEW AGRATIC HASTATO. INSURES OFEN SPACE VALAS.	CIES, DEBUTO,	TEMPORARY INCREASE IN MOISE AND DUST DURING CONSTRUCTION WITH ASSOCIATED REFECTS ON WILDLIFE.	PROVIDES WATER AND RESOURCE RECYCLING. PROMOTES WILDSIFE MANAGEMENT.
CAL STRIAMS. IMPROVEMENTS VALUES.	INCRESSED CONSTRUCTION ACTIVITY, POTENTIAL FOR DEVLOPERY OF CREEN BELTS. POSSIBLE REDUCTION IN SCENIC VALUES.	INSURES OF BUILDING CHECK ARKS. IN- CREASES FLOW IN LOCAL STREAMS.	COMMATTER WITH CALFORNIA PROTECTED WATERWAYS FLAM AND CALLEGRAIA SCENIC RICHARY FLAM.	INSURES OPEN SINCE ERECK MARKS. THORACIS FOR IN UCKL STELME, NAT, IN SHEE MING, LYFEING (FOR MATTEL, MATTELE VALUES,	SES FLOW DE LOCAL STREAMS. DEPROVEMENTS AL ASSULPTIO VALUES.	INCREASED CONSTRUCTION ACTIVITY. POTLOTIAL FOR DEVELOPMENT OF GREEN HELIS, POSSIBLE REDUCTION IN SCHALT VALUES.	INSURED OFEN SPACE CREEN AREAS. IN- CREASES FLOW IN LOCAL STREAMS.
97	PUTENTIAL FOR WALKING AND BICTICLING PATHS, AND MINI-PARKS.	INCREASEN USF OF EXISTENE AND NEWLY DEFECTIONS AND MAKES BASED SECREATIONS.	POTENTIAL INCREA BUNTING OPPORTUN SUCH AS BIRD WATE	POTENTIAL INCREASE IN WATER-ORIENTED RECKATION, SFORT FISHI- HUNTING OPPORTUNITES, POTENTIAL INCREME IN PASSIVE WATER SUCH AS EIRD WATCHING AND WALKING.	DNE AND OFFLAND GAME ENHANCED AGTIVITIES	FOTENTIAL FOR MALKING AND SICYCLING PATHS, AND MINI-PARKS,	INCREASED UNE OF EXISTING AND NEWLY DEFELOPED WATER BASED RECREATIONAL ARIAS.
FOR WASTEMATER STORAGE	MINIMEN IMPACT,	150 MEGNATT HOUSEDAY OF POSES ARE REQUIRED.	MINIMIN IMPACT	38,080 ACRES FOR WASTEWATER APPLICATION 900-ACRES FOR WASTEWATER STORAGE PACES.	N: 5,800-ACMES FOR SCINCIL APPLICATION; TILES.	MINIMUN IMPACT.	150 MEGANATT HOURS/DAT OF POWER ARE REQUIRED.
MACHINE OF SET OF OWE SETTLE- ME POTENTIALLY MATERIAL MACHINE, OW MELON MET DE- LIGHTON, OW MELON MET DE- LIGHTON, OW MELON MET DE- MENDETT, MATERIAL MACHINE, MATERIAL MACHINE, MATERIAL MATERI	PORTE MASICLEY TRANSITION, WITH SHE TO PRESENT WAS A CALLORED ON IN SHEETING WAS INCLUDED ON IN SHEETING WAS BEEN OF ACCOUNT OF THE WAS A WAS BEEN OF A CALLORED ON THE TO ACCOUNT OF THE TOWAS WAS TO WAS A WORK OF THE TOWAS WAS A COUNTY OF THE TOWAS WAS A CALLORED ON THE TOWAS WAS A COUNTY OF THE TOWAS WAS A COUNTY OF THE TOWAS WAS TOWN WAS A COUNTY OF THE TOWAS WAS TOWN WAS A COUNTY OF THE TOWAS WAS TOWAS TO WAS TOWAS WAS TO WAS TOWAS WAS T	1.900 ACRS OF THE TOPP CHARLES WILLD PARTICULARLY AFFOT THE DOMMANIC AND POPULATION OF SHARETING NO FOR THEASTEN AND THE TOPP THE SHARETING TO THE TOPP THE SHARETING THE	SYSTEM COULD POTENTIALLY SITE TO INCLUDE COURSE CARROLLY AND USE AND USE AND USE AS SHOULD SEE AS SOURCE OF THE USE OF THAT MADE IN STATE AS SPACE.	13, 560 ACRE OF COP COMPES MITED A ROUTH NEW YORKS WITED FOR COPY COPY OF THE PERMITTAL WASHINGTON FRANCES OF THE STORY WASHINGTON FRANCES OF THE STORY WITED STORY OF THE STORY WITED STORY OF THE PERMITTAL WORK GALN OF \$12 PROCESSORY.	TOTAL POPULATION OF 500 IN ONE STITLE MENT, 200 INSO ONE STITLE MENT, 200 INSO ONE STITLE MENT, 200 INSO ONE STITLE MENT OF THE PROPERTY OF STITLE MENT OF THE PROPERTY OF STITLE MENT OF THE PROPERTY ONE STITLE MENT OF STITLE PROPERTY ONE STITLE MENT OF STITLE PROPERTY ONE STITLE MENT OF STITLE PROPERTY ON STITLE OF MENT OF STITLE OF PROPERTY OF STITLE OF MENTS. MENTAL AFFACT OF STITLE OF MENTS.	POWER MASTERIN TRANSITIONS WITH STATE OF POTENTIAL BURDESS (MORNES) KNOWED LISS STATE WITHOUT WAS FOUR TO ACCESS STATE WITHOUT PARKE FOUR TO ACCESS STATE OF POTENTIAL BURDANDERS WITH TRANSITION WAS THE TRANSITY WITH TRANSITY WITH TRANSITY WITH THE WITH THE TRANSITY WITH THE TRANSIT	2.900 ARRE OF THE CROP CHANCES WHILD PARTICULARLY AFFOR THE CROSSING CAND PREACTION CAND PROPERTIES OF THE CROSSING CHANGES OF THE CROSSING CHANGES OF THE CROSSING CHANGES OF THE CROSSING CANDARD THE CANDARD CANDAR
		ANXIETY OVER LOSS OF SUCIAL STRUCTURE AND CORESION AND SOME ETHRIC GROUPS,	OPPOSITION FROM MONTEREY	COUNTY INTERESTS TO THE CONCERT OF INTERE	TRANSPORT		ANXIETY OVER LOSS OF SOCIAL STRUCTURE AND CORESTON AMONG SOME ETINIC GROUPS,
SYSTEM TO PORCE ALTERATION FE-STITE, AS WELL AS JOB AND RUFILON, POTENTIAL NUISANCE FUBLIC HEALTS EFFECTS.	AND INCOMENTATE OF PARAGO, SERVILE USES, AND INCOMENTATE ALLOWENT RESIDENTS, PUT TO ACCESS DISKUPTION, DIRE, DUST, AND NOISE DURING CONSTRUCTION PRASE.	STREAM OF MACHINERAM, CON- CERN OF MICKESS AND MITCHS STREAMS CONSTRUCTOR PRANS, CONCERN OR CONSTRUCTOR PRANS, CONCERN OF TORACES AND MICKERN OF SERVICES AND ADMINISTRATION, IN- PAIRMENT OF STREAM OF SERVICES AND ADMINISTRA	CONCERN OF STSTEM INFLUENCE INCREASE	CONCERT OF SYSTEM TO FORCE SLOTFFICANT ALTERATION TO FARM OFFEATION AND TROUBLE, AN THELM AS BROSSING PERSETTION, POTESTIAL SHERANCE, AND ANYBRE FURLIT BRAZIN EFFECTS.	CONCING OF SYSTEM TO PORCE ALTREATION OF WISHEL LIFE-SYSTEM, AS WELL AS OBS. AND MOUSEMENT ON, POTENTIAL NUTSANCE AND ADVENUE PUBLIC HEALTH EFFELTS.	AND TAKES OF PARROLES, SERVICE DESERS. AND TAKES AND TAKES TO SERVED AND TAKES, DIE TO ACCESS DESERVEDING, DERT, DUST, AND SOURCE DURING CONSTRUCTION FRASE,	EXCLALLY PRASSIS-AMERICANS, DONERS, OF BUSINESS AND SERVICES SERVALISMENTS OF ACCESS DESERVED BREAD DONE- THRUTTON PRASES. CONCERN OF DEMESTES AND RECORDERS OF PRESENCE AND RECORDERS FOR PRESENCE ST ST AND PROPERTY.
FUR STSTEM CONSTRUCTION. STEM, S44 MILLION FOR WUCTION ITSELF, AND		CONSTRUCTION NOMERS, CONSTRUCTION LONGACOUSE, TAKES ENDING, MATERIAL MANUFACTINES, TRANSPORTATION IS LUDGES, LANCERENA, FISAS, AND GROUPE ACTIVE IN MINORITY INTERESTS NOTED ALL BE AFFROID BY SYSTEM USES, AND		POTECTIVE OF TAILLING MAN BANK ON WORD NEW NEITHEN ONSTRUCTION OF TAILDINGS AND STATEMENT SHARE OF FLAMES AND STATEMENT SHARE STRUCTION. TOTAL SINCE AND SAL MILLION FOR MINORITY SHARE STRUCTION.	THE FOR SYSTEM CONSTRUCTION, SHOE WARRY TO THE WAY THE SHAPE OF TOTAL, SHOT MILLION FOR MINORITY SHAPE OF CON-		1988
CULD BE ABOUT \$2,000.		CONSTRUCTION FROGRAMS, AND SE PROVIDED WITH OFFICENCY FOR INCOME, JUSE, AND DEFENDEMENT OF SOCIAL AND INSTITUTIONAL PROCRAMS.		POTENTIAL GAN EMPLOYMENT O ARPIT F2,000. ANNUAL GAN	NOTESTAL GAN EMPLOYENT OF SYCEP IN FLACE MOULD BE ARPIT FA,000. ANNUAL GAN RAGES MOULD BE 528 MILLIN.		CONSTRUCTION PROGRAMS, AND ME PROVIDED STEEL OFFERENTY FOR INCIME, JOSS, AND DEFENDMENT OF SOCIAL AND INSTITUTIONAL PROGRAMS.
TERRATE NUISANCE ARHAL BUIC DISEASE TEANSMISSION BUIA STATE HEALTH ACENCIES. ITERAL CONTAMINANTS HAZARDOUS	TARINI MININIM	MTALONOM (MEDALET	PROVIDES CALATER CONTROL OF WATER-DORNE LAFACTIONS OFFICARE UNLER PHINGSNCY OF UVERLAND CONDITIONS.	THEY ALTERNATE WILL DETRINE ACTIONUES AND VESTIBATE NEEDER AND MEASURED FOR ALTERNATE AND EXCELSE THE VARIABLE FOR SOCIAL SESSION TRANSPORTED SOCIAL SESSION ACCOUNTY TO MAKE STREET, SINCE AND ACCOUNTY THE POTENTIAL SCIENCE FOR GRANDE OF ALTERNATE, SINCE WHARMANY S WANDOW TO HANCE.	O AND VESTGRAFE NUTSONCE ANDRE THE SOCIOUTY STATES TRANSPOSION FULL FOORTH STATE REALTH ANDRESS. IN AND COLLEGE STATE REALTH ANDRESS. IN AND COLLEGE STATE REALTH ANDRESS.	MANAGE BRACE	MINIMIN INDACT
MINIMON INPACT	MISCHON DRACT	MINISTRA DEBAGE	MASSE FORTLATION WILL BACK A PORTLAGO OF STATE COSTS (\$20 MILLION, FIGURE 15).	PORTIONS OF THE MASS" GLOBAL DOWLLA- TAW COST WILL HE SENDE BY LOCAL LANG- GRADE EDGEALER TO THEIR BORNEA, COSTS FOR LO-SALING AND GENERATION CONTESTIONAL HALLANTION SYSTEMS.	MINIMUM INPACT	MINIMEN DERVIT	MINIMEN INPACT
AND CROPS WHICH ARE NOT CASTALLED ON PARKERS FIRM TEAR FOR ANY IN-	MINIMUM IMPACT	MINIMUM INDACT	AVERAGE ANNIAL ACR (CHTESA, 18- COME LOSE 25 19,000, FRCINE LICSS AZ TEAR 2000 OF \$222,000.	RESTRICTED TO SECURISE USED HIGH RITHOG SALEN ASA, MASTERATES AND HARLS APPLI PROPERTY WILL BE COMPENSATED ON STRAIG CONVERTIBLE OF LOTHER.	KESTRICTED TO GROUPS USEN THEN STEROCES SCIENC CROPS AND CHOPS AND CHOPS AND CHOPS AND CHOPS AND CHOPS AND CHOPSEN AND MADERAL PROJECTION SYSTEM, AND CHOPSEN AND MADERAL PROJECTION SYSTEMATICS AND CHOPSEN AND CHOPSEN CONVENIENCE OF LINKEST.	MINIMUM IMPACT	MINIMUM IMPACT
MINIMEN DRYACT	NINIMIM IMPACT	MENTHUM EMPACE	TAN LINES YOR PURCHASHY LANDS ETG, 000.	MINIBON DONCE	STATISTICS CARRACT	MUNIMUM IMPACT	MINIMUM IMPACT
HININGH IMPACT	MINIMOM INFACT	MISINGN INDUSTR	MINIMA NUMBER	MINIMUM UNEGL	MINIBOR INFACT	MINIMUM IMPACT	MINIMUM IMPACT
OF 38,000 ACRES. \$380,000 PER YEAR.	MINIMUM IMPACE	MINIMA NUMBER	MANAGE ASSESSED	PROFINES TREATED WAITPWATTE FOR THE LABLESTICS OF 18,000 MARKS, VALUE DOS TO WAITPWATER AND SECRET APPLICATION 34.50,000 PER YEAR.	ALCATION OF 18,000 ALSES, FRETLIZER CLUMING 3456,000 PER TEAK.	MINIMUM INPACT	MINIMUM IMPACT
	MISINGH INDACT	MESSES 289-677	CAND APPLICATION PORTION IN THE RESERVE AND ACTION OF THE RESERVE AND ACTION OF THE RESERVE AND ACTIONS AND ADDICATED AND ACCOUNTS AND	COSTAN PORTION COULD BE INCLINISTED BY ECCESSION ON SIGNITA NOTITION ON A CONTRACT CARGINAL OF THE WASHINGTON, ON A CONTRACT CARGINAL OF A THREW WASHINGTON, A CONTRACT CARGINAL OF A CONTRACT CARGINAL OF THE CONTRACT CARGINAL OF A	A DEW WOLFE SALES STATES A TENN WOLF SALESCE STORTE. FEBRUAR STORTE.	NUMBER INFACT	MINIBON DAVACE
							FIGURE 16

		SUMMARY OF IMPACTS PRODUCED FROM INTERBASIN TRANSFER	F IMPACTS F	RODUCED F	ROM INTER	BASIN TRAN	VSFER
IMPACT		AL	TERNATIVE B	-3			
PARAMETERS	GENERAL	SITE POP FARMERS	POPULATION	CONVEYANCE LINE POPULATION	GROUPS	GENERAL	FARME
ENVIRONMENTAL QUALITY CHENICAL PHYSICAL FACTORS	PAOVIDES CAPACITY FOR LAND TREATHENT OF LOCAL MASTES. NEBET-LEIGH PRICENT RE- HOVAL OF PROSPHERS, NITROGEN AND ROD FROM MASTEMATEN WOULD BE POSSIBLE.	SLIGHT INCHESSE IN TOS OF LOCAL STREME. POSSINLE INCREASE IN TOS OF GROUNWAIRES, CHANGE IN LAND ASIA AND FLACINGST OF REFERE EXAM.	OSSIBLE ENCREAGE IN THE OF GROUNDWATERS. LAND AREA AND PLACEMENT OF RUPER GRAPS.	NUMBER AND SERVICE OF PETELOR. SHORT-THE DESCRIPTION OF PETELOR. PLATFILES NOT TO CONTROLLING.	WHILE PROFITED A REAKS FOR LOCAL COM- PLANMER WITH THE SAME SHARES WERE SHOULD THEN WHILE WHILE PLANKES OF ARREST FREE.	PRIVIDES CARACTOR FOR EAST PRACTICAL AND ADDRESS PROCESS. MARTI-GLOST PERCON. PROCESSES AND SAN SALVES AND SAN SALVESTER. SALVES OF PROCESSES.	SATURES, EMANCE IN THE OR THE SATURES, EMANCE IN SATURES, CONTRACT OF SATURES, SAMES,
ECOLOGICAL	POTENTIAL IMPROVEMEN EXISTING AND PROVIDE	POTENTIAL EMENUEMENT OF MABITAL RUB DESTRABLE SMALL CAME SPECIES EXISTING AND PROVIDES NEW AGMATIC MABITATS. INSURES OFFS SPACE.	SPECIES. IMPROVES SPACE AREAS.	TEMPORARY DURKALS IN MOTOL AND UNITED STREET, AND UNITED STREET, AND WILLIAMS WITH A SERVICE AT THE STREET, AND ST	PROVIDED MATER AND ALEGGED MACHILLEY. PRINCES WILDLIFF MANAGEMENT.	POSTERIAL DEPOCADO EXISTER AND PROVI	PORCHER, DESCRIBERY OF BARRAY FOR DELINERATION AND PROVIDES NEW ACCURACY MARKETS.
AESTMETIC	COMPATIBLE WITH CALIFORNIA PROTECTED WATERCAYS PLAN AND CALIFORNIA SCENIC HIGHMAT PLAN.	INSURES OF STACK CREEK ARMS, INCREASE MAY, IN SOME MINES, INVESTIGATE UPON MATTER.	KASES FLOW IN LOCAL STRIAMS. INPRIVEMENTS TITREL ANSTRUTTO VALUES.	DACAMAND OBSTRUCTOR ACTIVITY PUTSKILL FOR BEYELDHOUST OF CALR MAINS. POSKILL FOR EXPECTION IS BEEN KALIDS.	CHARLES OF STAND CHARLES ARRAIN, TA- CHARLES From 18 LOCAL STRACKS.		DECEMBER OFFICE OF STATES
RECREATION	POTENTIAL INCREASE IN HUNTING OPPORTURITE SUCH AS BIRD WATCHIN	POTENTIAL INCRASS IV MATES-NAEDYED KREMATIOS, SPORT FISHING AND UTLAND GAME ROWING OPPARTURITIES POTENTIAL INCRASE IN PASSIVE MATES ENGANCED ACTURITIES SUCH AS BIRD MATCHING. AND SHLAING,	PUTLAND GAME ED ACTIVITIES	POTENTIAL FOR SALKING AND BENYDLING PATES, AND MEST-PARES.	INCREASE DAY OF EXISTING DESCRIPTIONS AND STREET STREET, AND STREET, AND STREET, AND ADDRESS.	POTENTIAL THORNA SHINTISC CHRONICS THORNA AN SIRE AND	POTENTAL DICEASE DA MATER-SELECTE SON SENTENCE OPPORTUNITIES, POTENTAL INVESTIGATION AND MALKERO.
USE OF NATURAL RESOURCES	MINIMUM IMPACT	38,000 ACRES FOR MASTEMATER APPLICATION, PACILITIES.	N, 900 ACRES FOR MASTEMATER STORAGE	MINIMEN DEFAULT.	THE RESEARCH MERSE DAY OF TONIO ARE APPLIED.	MINIMIN INSACT	28, DOL ACKES POR ALL POP ACKES FOR MALTIN
SKIM, WILL-HING	SYSTEM COULD POTENTIALLY HELP TO IN- FLEMENT GENERAL LAND USE, AND DEVELOPMENT ANTIES MILITIES. "SHOW ALKES OF SYSTEM USED LAND, WHILD BE DEVILLED USES THAT WILLD INSURE METERATION AS OPEN STACE.	15.500 ARRES OF COOF CHANGES WOULD RESULT. NE STATEMENT ANNALL SHORM TORS (1575-2025). (SEE "MICHORRIC" FOR ENVIRE CHANGES, POTENTIAL OFFEND SEDI-LICENST OF 270 ARRES WOULD RESULT. IN NIT AVENOR ANNALL INCHRE GAIN OF 922 TREGGAND.	OF TOTAL PRODUCTION OF 550 IN ONE SETTLE- ALL PRINCE PROPULATION, OF WITCH ME DE- ALL PRINCE PROPULATION, OF WITCH ME DE- COOP GLARGES, FORESTIA, ME CALLUM COOP GLARGES, FORESTIA, ME CALLUM OF SOURCE PRELIABENT, AREACHER, MICHAEL SERVICE, AND MANUES LANGE, MAY STRUCK SERVICE, AND MANUES LANGE, MY STRUCK PRINCELLA REPORT OF STRUCK TO ME AND SERVICE AND SERVICE OF STRUCK AND SERVICE AND SE	PORCE ASSIGNATOR SAND THEN, AT EXAMPLE OF THE COMPETITION OF THE COMPE	A yes actes on the Choice Section Sect	FOTON COULD POTRACTALINY WILE TO RECOGNIZE AND THE AND	15, 500 KRRI DE DE RESERVE EN ESTADOR DE SERVE ANDES ESTADOR DE SERVE EN ESTADOR DE SE
	OPPOSITION FRO TRANSPORT OF T	OPPOSITION FROM MONTEREY COUNTY INTERESTS TO THE CONCEPT OF TRANSPORT OF TRANSPORT OF TREATED MASTEMATER.	FISTERBASIS	Monocored Brand and Performent Person of the	AMILIATE ONES LOSS OF MACAL STRUCTURE AND EXPERIMENT AMONG MACH TITLES GROUPS, INSTITUTE OF THE PARTICULAR OF THE PARTIC	OF WASTERNIE.	CODYTY STREETS TO THE
PUBLIC ATTITUDES	CONCERN OF SYSTEM EFFECT TO POSSIBLY INFLUENCE INCREASED URBANIZATION OF REGION.	CONCEX OF SYSTEM TO FORCE STORIETCANT ALTERATION TO FARM OFERATION AND INCOME, AS WELL AS STOSING DESIDETION, DOINGTEN, NUISANCE AND ANYERSE PUBLIC HEALTH REPECTS.	CONCERN OF SYSTEM TO PUBCE ALTERATION OF RURAL LIFE-STYLE, AS WELL AS OB AND HOUSING DISHUPLION, POINTIAL NUISANCE AND AURESE PUBLIC HEALTH RFECTS.	AND EMBELTY ATTORNEY MISTERS, DOR TO ACCESS DESIRITION, DEST, DOST, AND NO.GE DUSING CHARREST TON PARKE.	CRM of BELYEL AND INTELED DEBALED. MET'S USE ACCORD SENSITIVE METAL OFFICERS OF TOWNERS OF STORY ACCORDANT.		CONCERS OF EVITEM TO ALTERATIVE AND STAND OFFICE AND ALTERACE AND ADVISABLE AFFICES.
DISTRIBUTIVE EQUITY (CONSTRUCTION, OPERATION & MAINTENANCE MACES)		POTENTIAL OF 7 MILLION WAS DAYS ON SOURCE SAND SOURCES, SAND STORM, \$220 MILL SAND STREAM, \$270 MILL SAND FIRE MINNETTY SHARE OF SYSTEM SANDLE SAND SENDONS OF SYSTEM SANDLE ON \$250 MILL SANDLE SAN	S ON MORE WEIGHD FOR SYSTEM CONSTRUCTION. MILLION FOR CONTACTION, 564 MILLION FOR OF CONSTRUCTION INSELF, AND OF CONSTRUCTION. MILLION. MILLION.		ORDERON ROBERTO CONTROL DE CONTROL DE ROBERTO DE LA MATERIA DE LA CONTROL DE LA RECUERTO DE LA CONTROL DE LA RECUERTO DE LA CONTROL DE LA LES APPLICADOS DE LA CONTROL DE LA CONTROL DE LA CONTROL DE CONTROL DE LA CONTROL DE PERSONA DE CONTROL DE LA PORTA DE LA CONTROL DE PORTA DE LA CONTROL DE LA PORTA DE LA CONTROL DE PORTA DE LA CONTROL DE LA CONTROL DE LA CONTROL DEL CONTROL DE LA CONTROL DE LA CONTROL DE LA CONTROL DE		PHINTIAL OF 7 MILLION IN INCIDENT SALE SITLED STATES STRUCTING. STRUCTING. POTENT IS ABOUT 15
PUBLIC HEALTH	PROVIDES GREATER CONTROL OF WATCHENENE INFECTIOUS DISEASE UNDER EMERGENCY OR OVERLAND CONDITIONS.	THE ALTERATOR WILL INDIRECT ATTREBUTED FOR STREET APPROPRIATE SUGGESTION THE PARTY FOR GREATER CONTR. THE PARTY FOR GREATER CONTR. THE WASHERS AND THE PARTY FOR GREATER CONTR.	ARTHROPO AND VESTEBBATE SULANCE AND MACHINE OF A LONGOIT DISEASE TRANSMISSION AND ACTOR HANTH AND MODELS. DISTOR OF ALEVORIA STATE HANTH AND MODELS. DISTOR OF AND VESTEINFALL CONTACTIONNESS HANDRONS	MISSING DOVE	Taken Minoria	MANTHEL DEBTIE CONTROL OF WATERWISE BYZGLICH STELEN POSCE PUBLICATOR OFFILIAL ORGITHORS.	THE ALTREACTOR WILL ROLL AND THE REAL ADDRESS AND THE REAL ADDRESS AND THE ROLL ADDRESS AND THE ROLL AND THE
ECONOMIC PROIECT COSTS (\$1000)	BASIN POPULATION WILL SEAR A PORTUN OF STATE COSTS (\$22 WILLION, FIGURE 12),	PORTIONS OF THE BATIN'S CARRIAL POPULATION COST WILL BE BORNE BY LOCAL LANDSWING EQUIVALENT OF HEIR MORAL COST FOR (SEALING AND OPERATING CONVENTIONAL (SEALING AND OPERATING CONVENTIONAL	MINIMUM INDUST	MINIMIN DRIVES	DOWN HEAD	MATHE PROTECTION WILL HORE A PROCESSOR STARTS CONT. (NA MILLON, PERMY U).	POSTIONS OF THE BASIN'S TOUGHTS WILL BE DOING SCHOOL SCHOOLSEN TO THE FOR LOCKLEDIN AND SPIN UNIVERSIDES SYSTEMS.
AGRICULTURAL PRODUCTION	AVERACE ANNUAL ACRICULTURAL INCOME LOSS \$514,000. INCOME LOSS AT YEAR 2000 OF \$281,000.	RESTRICTED TO CROWING ONLY HIGH RITHOGEN UNING CROPS AND CROPS AND AND AND AND AND WATLACTION SYSTEM (SYSTALED ON PARKERS AND DAYS) WITH LEATH OF SYSTEM (SYSTALED ON ADDRESS SYSTEM (SYSTEM ON ADDRESS SYSTEM ON ADDRESS SYSTEM OF THE TEAR FOR ANY INCOMPRESSED ON ADDRESS SYSTEM OF THE TEAR FOR ANY IN-	N USING CROPS AND CROPS WHEN ARE NOT ATTOM STATEM INSTALLED ON FAMILIES SAG PER AGRE PER YEAR POR ANY LIN-	MINIMIN ONNELL	MUNICIPAL SAPACE		NACHOLIST TO OCCUPATION OF THE PART PART PART NACH AND CONTRACTION OF LOSS OF THE PART OF
PUBLIC FINANCE	TAX LOSS FOR PURCHASED LANDS \$24,000	MUNIMUM DAPACT	MINIMUM IMPACE	HANNING MUNICIPALITY	MINIMA DOACE		MINIMUM DE
LAND VALUES	MINIMUM IMPACT	MINIMON DRAWT	MINIMUM IMPACT	MANNE DEACT	MINIMUM (MONEY		
RECLAMATION OF RESOURCES	MINIMUM IMPACT	PROVIDES TREATED WARDENATES FOR T FERTILIZEN VALUE TO TO WASTENATES	ON THE IRRIGATION OF NA, OND ACRES. MATER APPLICATION \$380,000 FER YEAR.	MINIMUM TREATS	Ended Reckly		PACULTUS TREATES SA SALITE BUT TO MASSION
INSTITUTIONAL	LAND APPLICATION PONTION TO ANY ANAGEMENT AND	LAND APPLICATION FORTION COULD BE INPLICATED BY EXISTING ON HILDORING WOUTHED INSTITUTIONS. JOINT LEXERIES OF PORTES ANAXOGENERS ON CLIMITON OF A WAY WITHAMAD MANAGENER. PARAZE ARE POSSIBLILITIES. ONLY ON INSTITUTIONAL AGAINST SHOULD CONTOUL AND APPLICATION SOBSTERM. IN GANNAGE, STAIL AND FEBRUARY SHOULD CONTOUR. ADEQUATE TO ALD IN SPILEDENTING LAND FOREIGN.	SKOLTER SATTSACTOR OTLE CONTRAL HITES ARE	HUNDARI BROSET	EDVINC HONOLOGY	CASE APPLICATION PORTES COURS BE REPUBLISHED TO PROSESS ARE SOOTH NAMEDICAL MITTER TEXALISTS OF PROSESS ARE SOOTH AND AND APPLICATION SERVICINES. AND ONE AND APPLICATION SERVICINES. SERVICINES AND ADDICATED TO AND UNDERSTOONED.	A COULD BE INTERPRED BY COULD BY TOOLS AND COUNTY AND POSSIBLIFIES AND PATCHING SERVICES. US TO US DOWN TOOLS IN LONG.
						THE RESIDENCE OF THE PROPERTY	

TABL 37

USE OF RESOURCES 1/

First Cost (\$ Billion)2/ Average Annual Cost (\$ Million)* Electricity (Megawatt Hrs/Day) 2/ Natural Gas (Cubic Feet/Day) 2/ 18,900						
9,	.6 2.0	2.9	3.0	2.5	3.3	2.1
	447 355	482	437	366	472	357
	30 7,680	11,510	13,100	11,900	15,800	5,710
	006,81 00	18,900	20,550	20,550	20,550	20,800
Chemicals (Tons/Day) 2/	700 90	565	530	30	365	1 100
anol			165	10	115	350
Carbon			20	0	. 15	07
Chlorine	50 40	45	50	07	45	70
Land Application of Wastewater Acre-Feet/Year Million Gallons/Day	560,000 560,000 770,000 850,000 850,000 1,050,000 510 510 700 700 770 770 960	770,000	850,000	850,000	1,050,000	1 1
Land Required (acres)						
Agency Use Land Treatment Facilities 2,150	50 2,100	2,150	2,900	2,900	3,000	1
			000	000	000	
lcation		-	148,000	7		1
Sludge Disposal 48,000	000,74 000	48,000	48,000		48,000	47,000
Wastewater Storage 9,300		10,700	14,300		15,800	1
Subtotal 154,300	15	-	210,300	SI	249,800	47,000

Condition costs are shown in Table 32. Base Condition resource requirements are as follows: Electricty, 1,280 Megawatt Hrs/Day - Natural gas, 13,430 Cubic Ft/Day, Chemicals in tons/day Lime, 175 - Chlorine, 30. Costs do not reflect financial benefits from the use of reclaimed water and nutrients.

This illustrative tertiary treatment system is included for general comparison purposes only and does not reflect the same level of detailed analysis as the land application alternatives.

FEATURES AND EXPECTED ACCOMPLISHMENTS

307 Local, 20 State and 120 Federal. For the Bay-Delta Region population, per capita local anstorage in reservoirs. Regionwide sludge disposal system. Annual costs (\$ million) Surface water disposal for 940 mgd after full tertiary treatment. Land application within the study area for 510 mgd after treatment in biological secondary treatment nual costs would be about \$33 by the year 2000.

ALTERNATIVE B-1

augmentation, industrial cooling or additional irrigation water. Within the B-Series alternatives this alternative minimizes land requirements and along with Alternative B-3 provides the highest in fertilizer benefits yearly and up to 125,000 acre-feet/year of purified water for streamflow EXPECTED ACCOMPLISHMENTS. Meets 1983 requirements of PL 92-500. Provides recycled irrigation water for 97,000 acres. Insures over 150,000 acres of open space. Reclaims over \$1.4 million

level of treatment for both water and land-oriented discharges.

ment plants and storage in reservoirs. Regionwide sludge disposal system. Annual costs (\$ million 237 Local, 16 State and 102 Federal. For the Bay-Delta Region population, per capita local annual FEATURES. Surface water disposal for 940 mgd after advanced wastewater treatment. Land application at 7 sites within the study area for 510 mgd after treatment in biological secondary treatcosts would be about \$26 by the year 2000.

ALTERNATIVE B-2

Within the B-Series alternatives this alternative also minimizes land requirements but allows more pollutants to be discharged to in fertilizer benefits yearly and up to 125,000 acre-feet/year of purified water for streamflow Meets 1977 requirements of PL 92-500. Provides recycled irrigation water for 97,000 acres. Insures over 150,000 acres of open space. Reclaims over \$1.4 million augmentation, industrial cooling or additional irrigation water. surface waters than do Alternatives B-1 and B-3. EXPECTED ACCOMPLISHMENTS.

at 8 sites (including interbasin transfer) for 700 mgd after treatment in biological secondary treatment plants and storage in reservoirs. Regionwide sludge disposal system. Annual costs FEATURES. Surface water disposal for 750 mgd after full tertiary treatment.

Land application

(\$ million) 332 Local, 22 State and 128 Federal. For the Bay-Delta Region population, per capita local annual costs would be about \$36 by the year 2000.

augmentation, industrial cooling or additional irrigation water. Within the B-Series alternatives the highest level of treatment for both land and water-oriented discharges. Because of the larger this alternative had the largest requirement for land. It provides, along with Alternative B-1, flows to land this alternative minimizes the discharge of pollutants to surface water within the water for 135,000 acres. Insures over 190,000 acres of open space. Reclaims over \$1.8 million in fertilizer benefits yearly and up to 145,000 acre-feet/year of purified water for streamflow EXPECTED ACCOMPLISHMENTS. Meets 1983 requirements of PL 92-500. Provides recycled irrigation

TABLE 38 (Cont'd)

and storage in reservoirs. Regionwide sludge disposal system. Annual costs (\$ million) 281 Local, 7 sites within the study area for 770 mgd after biological secondary treatment in aeration lagoons Land application at 22 State, 134 Federal. For the Bay-Delta Region population, per capita local annual costs would Surface water disposal for 680 mgd after full tertiary treatment. be about \$31 by the year 2000.

ALTERNATIVE D-1

augmentation, industrial cooling or additional irrigation water. Within the D-Series alternatives this alternative minimizes land requirements and along with Alternative D-3 provides the highest water for 148,000 acres. Insures about 210,000 acres of open space. Reclaims over \$1.9 million In fertilizer benefits yearly and up to 230,000 acre-feet/year of purified water for streamflow Meets 1983 Requirements of PL 92-500. Provides recycled irrigation evel of treatment for both land and water-oriented discharges. EXPECTED ACCOMPLISHMENTS.

tion at 7 sites within the study area for 770 mgd after biological secondary treatment in aeration 229 Local, 20 State and 117 Federal. For the Bay-Delta Region population, per capita local annual PEATURES. Surface water disposal for 680 mgd after advanced watewater treatment. Land applicaagoons and storage in reservoirs. Regionwide sludge disposal system. Annual costs (\$ million) costs would be about \$25 by the year 2000.

ALTERNATIVE D-2

153

augmentation, industrial cooling or additional irrigation water. Within the D-Series alternatives water for 148,000 acres. Insures about 210,000 acres of open space. Reclaims over \$1.9 million this alternative also minimizes land requirements but allows more pollutants to be discharged to in fertilizer benefits yearly and up to 230,000 acre-feet/year of purified water for streamflow EXPECTED ACCOMPLISHMENTS. Meets 1977 requirements of PL 92-500. Provides recycled irrigation surface water than do Alternatives D-1 and D-3.

at 8 sites (including interbasin transfer) for 960 mgd after biological secondary treatment in Land application aeration lagoons and storage in reservoirs. Regionwide sludge disposal system. Annual costs (\$ million) 305 Local, 24 State and 143 Federal. For the Bay-Delta Region population, per Surface water disposal for 490 mgd after full tertiary treatment. capita local annual costs would be about \$36 by the year 2000.

ALTERNATIVE D-3

water for 186,000 acres. Insures up to 250,000 acres of open space. Reclaims over \$2.3 million alternative has the largest requirement for land. Within the D-Series alternatives it provides, along with Alternative D-1, the highest level of treatment for both land and water-oriented disin fertilizer benefits yearly and up to 250,000 acre-feet/year of purified water for streamflow augmentation, industrial cooling or additional irrigation water. Of all the alternatives this Meets 1983 requirements of PL 92-500. Provides recycled irrigation Because of the larger flows to land, this alternative allows fewer pollutants to be discharged to surface waters than any of the other alternatives. EXPECTED ACCOMPLISHMENTS.

(Cont'd) TABLE 38

State, 194 Federal. For the Bay-Delta Region population, per capita local annual costs would be FEATURES. This system was developed to provide a cost comparison to the land application alternatives and to present a regionwide sludge disposal system. The system provides surface water disposal for 1,450 mgd after full tertiary treatment. Annual costs (\$ million) 246 Local, 17 about \$26 by the year 2000.

TERTIARY TREATMENT

EXPECTED ACCOMPLISHMENTS. Meets 1983 requirements of PL 92-500. Insures up to 47,000 acres Reclaims over \$470,000 in fertilizer benefits yearly. open space.

NOTES:

- Renovated water from the tertiary and advanced treatment facilities in all alternatives (and from the full tertiary treatment system) could also be available for local reuse.
- The following assumptions were made in apportioning annual costs: 2.
- Cost sharing for amortization of first cost was 12.5 percent local, 12.5 percent State and 75 percent Federal. a.
- Replacement and operation and maintenance costs were considered to be local responsibility Ъ.
- Total flows (in mgd) have been rounded 3.

EVALUATION

260. Six final alternatives, incorporating various degrees of land application, have been developed by this study for wastewater and sludge management in the San Francisco Bay and Sacramento - San Joaquin Delta Region. Up to this point these alternatives have been fully discussed from an engineering viewpoint and their impacts on the Bay-Delta Region (including the northern portion of the Central Coastal Basin), the State of California and the United States have been identified. The next planning event scheduled for the alternatives is that of evaluation.

261. Evaluating a program or a proposal usually requires the identification of two aspects of the action, its magnitude (meaning its extensiveness or scale) and its importance (which is a value judgment). In this evaluation, however, only the magnitude aspect of the alternative action will be considered, since analysis of this aspect is based on fact and since it is outside the scope of this study to make value judgments on the alternatives. The goal of this evaluation then, is to objectively describe the degree of change that each of the six final alternatives (B-1, B-2, B-3, D-1, D-2, and D-3) would likely produce if it were employed in the solution of wastewater management problems in the Bay-Delta Region without making any preference decisions on a specific alternative.

262. In the evaluation methodology, each alternative was conceptually implemented in the San Francisco Bay-Delta Region, as defined by the 1975 Base Condition and its regional characteristics. The changes likely to occur in the region as a result of an alternative were then recorded under four general accounts characterized by parameters used in the summary impact display (Figures 10 through 16) presented earlier. The four evaluation accounts were Environmental, Social, Economic, and Special Considerations. The first three accounts are more or less traditional evaluation accounts while the last was added as a miscellaneous account. To define the evaluation accounts and to further categorize impacts, each account was divided into its component parts. For example, the Environmental Account was divided into four components: Chemical/Physical Factors, Ecological Associations, Aesthetic/Cultural and Recreation. Table 39 shows the breakdown of all the evaluation accounts.

263. To obtain a certain degree of objectivity both beneficial and detrimental aspects were considered as well as certain and potential opportunities and concerns. Accordingly, the evaluation is consistent with the following:

Beneficial Aspects

Detrimental Aspects

Beneficial Effects are those positive changes that would occur if the plan were implemented.

Detrimental Effects are those negative changes that would occur if the plan were implemented.

Beneficial Opportunities are those positive changes that could occur if appropriate actions were taken over and above plan implementation.

Detrimental Concerns are those changes that could occur if appropriate actions were not taken over and above plan implementation.

264. The scope of the evaluation is regional and emphasizes the effects of greatest moment associated with the total alternative, rather than a display of specific effects by area or population group. Because of the similarities between alternatives, some of the effects recorded are common to all of the alternatives. Figures 17 through 40 present the evaluation of the six final wastewater management alternative (B-1, B-2, B-3, D-1, D-2, and D-3) developed by this study. Four figures (one for each evaluation account) are provided for each of the six alternatives. A more detailed discussion of the procedure for evaluating the alternatives can be found in Appendix B-7, Evaluation.

TABLE 39

EVALUATION ACCOUNTS AND COMPONENTS

SOCIAL	ECONOMIC	SPECIAL CONSIDERATIONS
Area Viability	Costs	Reclamation of Resources
Public Attitudes	Production	Use of Resources
Distributive Equity	Public Finance	
Public Health		
	Area Viability Public Attitudes Distributive Equity	Area Viability Costs Public Attitudes Production Distributive Public Finance Equity

B ENVIRONMENTAL EVALUATION-ALTERNATIVE

BENEFICIAL)

CHEMICAL/PHYSICAL FACTORS ECOLOGICAL ASSOCIATIONS AESTHETICS CULTURAL

RECREATION

THE TREATMENT PROCESSES (LAND AND FULL TERTIARY) IN THIS ALTERNATIVE REMOVE FROM 98 TO 99 PERCENT OF THE BIO-CHEMICAL OXYGEN DEMAND (BOD), TOTAL NITROGEN (TN) AND TOTAL PHOSPHORUS (TP) PROM THE WASTE STREAM. WHILE TERTIARY TREATMENT IS NOT AS EFFICIENT IN REMOVING TOXIC METALS (85%) AS LAND TREATMENT (98%), THE OVERALL REMOVAL OF TOXIC METALS IS AT THE HIGHEST PRACTICABLE LEVEL. BECAUSE OF HIGH REMOVAL RAITES AND NO DISCHARGE TO SUISUN BAY, THIS ALTERNATIVE WILL AID NATURAL PROCESS IN FLUSHING IN-SITU POLLUTANTS FROM THE ESTUARY.

THE AVAILABILITY OF WATER, "FERTILIZER"
AND SOIL CONDITIONERS WILL ENHANCE
AGRICULTURAL PRODUCTIVITY OF THE LAND
AREAS. OPEN SPACE PRESERVES WILL BE
CREATED AND MAINTAINED.

THIS ALTERNATIVE WILL GREATLY REDUCE
THE ENVIRONMENTAL STRESS EXERTED ON
THE BIOTIC COMMUNITIES OF THE BAYDELIA ESTUARY BY MUNICIPAL AND INDUSTRIAL WASTES. IT WILL IMPACT MOST
ON ACUTE TOXICITY STRESS AS THE CONSTITUENTS RESPONSIBLE FOR THIS STRESS
ARE FOUND PRIMARILY WITHIN THE MUNICIPAL AND INDUSTRIAL WASTE STREAM,
CHRONIC POXICITY DUE TO BIOACCUMULATION OF HEAVY METALS AND PESTICIDES
WOULD ALSO BE REDUCED. BIOSTIMULATION POTENTIAL WOULD BE GREATLY
CURBED IN THE SOUTH BAY AND AT LEAST
STABILIZED AT 1975 LEVELS IN SAN
PABLO BAY, SUISUN BAY AND THE DELITA.
THE BIOLOGICAL RESPONSE TO THIS
ALTERNATIVE, ALTHORICH BUFFERED BY
OTHER WATER QUALITY AND QUANTITY
PROBLEMS, WOULD BE A SUSTAINED INCREASE IN THE CARRYING CAPACITY OF
THE ESTUARY AND CONTIGUOUS WETLANDS.

THIS ALTERNATIVE WILL PROVIDE PERMANENT OPEN SPACE AND OPEN WATER PRESERVES. IN CROP AREAS THE RURAL AGRICULTURAL CHARACTER OF THE AREA MOULD BE PERMANENTLY RETAINED AND IN GRAZING AREAS THE CHANGE IN VEGETATIVE COVER WOULD COMPLEMENT THE SURROUNDING NATIVE COVER TYPE. THE BEAUTIFICATION PROGRAM ACCOMPANY-ING THE CONVERSION OF TRRAIMENT PLANTS TO PUMPING STATIONS WILL ENHANCE THEIR VISUAL PROFILE. SINCE PIPELINE ROUTES WILL HAVE TO REMAIN OPEN FOR MAINTENANCE PURPARENT OF THEIR VISUAL FOR GREEN BELTS IN URBAN AREAS EXISTS.

IMPROVED WATER QUALITY IN THE ESTUARY AND INCREASED FLOW IN LOCAL STREAMS WILL ENHANCE THE SENSORY VALUE OF THE REGION'S WATERWAYS.

BY IMPROVING WATER QUALITY THIS ALTERNATIVE COULD INCREASE ACTIVE AND FASSIVE
WATER-ORENTED RECREATIONAL ACTIVITIES
ASSOCIATED WITH THE BAY-DELIA ESTUARY.
PLANNING AND DEVELOPMENT IN THE APPLICATION SITES ARE DIRECTED TOWARD THE
PRESERVATION OF FARM AND NATURAL LANDS
AS OPEN SPACE, SCENIC ELEMENTS AND
POSSIBLE RECREATIONAL AREAS. WITH 47%
OF THE OUTDOOR RECREATION PARTICIPATION
OCCURRING WITHIN THE ZERO TO ONE HOUR
TRAVEL ZONE FROM METROPOLITAN AREAS, THE
RECREATIONAL USE OF OPEN SPACE PROVIDED
BY THIS ALTERNATIVE WOULD BE BENEFICIAL
IN MEETING INCREASING ACTIVE AND PASSIVE
WATER-ORIENTED DEMANDS.

(DETRIMENTAL)

THE TREATMENT PROCESSES (LAND AND FULL TERTIARY) WILL NOT EFFECTIVELY REMOVE TOTAL DISSOLVED SOLIDS (TDS) FROM THE WASTE STREAM. IN FACT LAND TREATMENT MAY INCREASE THE TDS OF RETIRN WATER. THE MAGNITUDE OF IMPACT RESULTING FROM THE DISCHARGE OF HIGH TDS WATER WILL VARY WITH THE USE OF THE RECEIVING WATER.

THE LAND WILL UNDERGO EXTENSIVE SHORTTERM ALTERATION DUE TO THE CONSTRUCTION
AND PLACEMENT OF TRAINGENT FACILITIES
AND UNDERDRAINS. LONG-TERM IMPACTS MAY
BE REALIZED IN THE CONVERSION OF WILD
LAND TO MANAGED LAND, THE PERMANENT
COMMITMENT OF LAND TO TRAINGENT FACILITIES AND THE POSSIBLE BUILD-UP OF
HEAVY METALS IN THE SOIL.

POST CON-WILL CAUSE AN INITIAL REDUCTION IN IN-DIGENOUS ANIMAL SPECIES DUE TO DIRECT WHERE A RADICAL CHANGE OF COVER TYPE HAS OCCURRED DUE TO INCREASED MOISTURE, NEW BIOTIC COMMUNITIES WILL DISPLACE OF NATIVE VEGETATION, RE-INHABITATION WILL BE SLOW. IN INUNDATED AREAS THERE WILL BE NO RECOVERY. AQUATIC CONSTRUCTION ON SYSTEM REQUIRED LANDS PLANNING HAS PROVIDED FOR RESTORATION RETURN WATER FROM THE LAND AREAS WILL LOSS OR AVOIDANCE MIGRATION. POST CO STRUCTION RECOVERY SUCCESS WILL VARY WITH THE NEW HABITAT TYPE. IN AREAS CONDITIONS IN THE STREAMS RECEIVING BE MODIFIED BY INCREASED TDS. THIS SPECIES IN STREAMS WHERE TDS VALUES THE EXISTING ONES. IN AREAS WHERE IMPACT WOULD BE CHARACTERIZED BY A SHIFT IN THE AQUATIC AND RIPARIAN COMMUNITIES TO MORE SALT TOLERANT AND DILUTION RATES ARE LOW.

CONSTRUCTION WILL CAUSE TEMPORARY VISUAL DECRADATION OF EXISTING SYSTEM REQUIRED LANDS. EVEN AFFER LANDSCAPING, BUFFER ZONES AND OTHER MITIGATIVE MEASURES HAVE ACHIEVED MATURITY THERE MAY REWAIN AN INTRUSIVE IMPACT OF MAN-MADE SYSTEMS IN THE NATURAL ENVIRONMENT.

ALTHOUGH HISTORICAL SITES AND ARCHAEOLOG CAL SITES WILL BE PROTECTED BY BUFFER ZONES AND VEGETATION SCREENS SOME OF THEIR SIGNIFICANCE MAY BE LOST BY OBSTRUCTION OF SETTING.

ACTIVE RECREATIONAL PURSUITS ON THE LAND SITES WILL BE LIMITED. CONSTRUCTION AND THE PERMANENT COMMITMENT OF LAND TO TREATMENT FACILITIES COULD DEGRADE AND/OR DISPLACE THE CURRENT RECREATIONAL USE OF THE LAND.

ENVIRONMENTAL EVALUATION -ALTERNATIVE B-2

(BENEFICIAL)

RECREATION

CHEMICAL/PHYSICAL FACTORS ECOLOGICAL ASSOCIATIONS AESTHETICS CULTURAL

THE TREATMENT PROCESSES (LAND AND ADVANCED TREATMENT) IN THIS ALTERNATIVE LIMIT MASS DO NOT EXCEED THOSE OF THE BASE CONDITION EMISSION OF CONSTITUENTS TO TOTALS WHICH ALTHOUGH, THE TREATMENT PLANT COMPONENTS OF THIS ALTERNATIVE ARE NOT AS EFFICIENT BOD AND HEAVY METALS APPROACHES TERTI-AS TERTIARY TREATMENT IN REMOVING CON-ALTERNATIVE B1, THIS ALTERNATIVE PRO-VIDES NO DISCHARGE OF TREATED WATER STITUENTS, ITS REMOVAL OF IN, TP, ARY LEVELS AND CERTAINLY IS ABOVE SECONDARY TREATMENT LEVELS. LIKE TO SUISUN BAY.

VITY OF THE LAND AREAS. OPEN SPACE PRESERVES WILL BE CREATED AND MAIN-ENHANCE THE AGRICULTURAL PRODUCTI-THE AVAILABILITY OF WATER, "FERTI-LIZER" AND SOIL CONDITIONERS WILL

UNDER THIS ALTERNATIVE ECOLOGICAL STRESS IN THE ESTUARY DUE TO MUNICIPAL AND IN-DUSTRIAL WASTE DISCHARGES WOULD BE AT LEAST STABILIZED AT 1975 LEVELS IN SPITE OF FUTURE INCREASES IN FLOW. INITIALLY, ASTE FLOWS INCREASE AND FLUSHING FLOWS AN INCREASE IN THE CARRYING CAPACITY OF RENTLY EXPERIENCING ACUTE WATER QUALITY TOXICITY, EUTROPHICATION POTENTIAL AND PERSISTANT POLLUTANT CONCENTRATIONS IN THE CONSTITUTING RESPONSIBLE FOR THESE POINT WHERE BY PRUJECT YEAR 2000 THEIR DECREASE, AS EXPECTED IN THE FUTURE, PROBLEMS WOULD GRADUALLY INCREASE TO THE IMMEDIATE BIOLOGICAL RESPONSE TO IMPROVET HABITAL CONDITIONS WOULD BE LOADS WOULD AGAIN BE AT 1975 LEVELS. THE TREATMENT PROCESS WOULD REDUCE HOWEVER, AS AREAS IN THE ESTUARY THAT ARE CUR-THE RECEIVING WATERS. DEGRADATION.

THIS ALTERNATIVE WILL PROVIDE FERGENES.

OPEN SPACE AND OPEN WATER PRESERVES. IN NATIVE COULD INCREASE ACTIVE AND PASSIVE CROP AREAS THE RURAL AGRICULTURAL CHARACTER NATIVE COULD INCREASE ACTIVE AND PASSIVE NATIVE OF THE RURAL AGRICULTURAL PERFAINED.

WATER-ORIENTED RECREATIONAL ACTIVITIES OF THE AREA WOLLD BE FEATUREALLE NEGETS.

ASSOCIATED WITH THE BAY-DELTA ESTUARY.

TIVE COVER WOULD COMPLEMENT THE SURROUNDING AND DEVELOPMENT IN THE APPLIMATURE COVER TYPE. THE REAUTIFICATION CATTON SITES ARE DIRECTED TOWARD THE NATURE. SINCE PIPE-OF THE AREA WOULD BE PERMANENTLY RETAINED TREATMENT PLANTS TO PUMPING STATIONS WILL LINE ROUTES WILL HAVE TO REMAIN OPEN FOR MAINTENANCE PURPOSES, A POTENTIAL FOR NATIVE COVER TYPE, THE BEAUTIFICATION THIS ALTERNATIVE WILL PROVIDE PERMANENT PROGRAM ACCOMPANYING THE CONVERSION OF GREEN BELTS IN URBAN AREAS EXISTS. ENHANCE THEIR VISUAL PROFILE.

IMPROVED WATER QUALITY IN THE ESTUARY WILL ENHANCE THE SENSORY VALUE OF THE AND INCREASED FLOW IN LOCAL STREAMS REGION'S WATERWAYS.

TRAVEL ZONE FROM METROPOLITAN AREAS, THE IN MEETING INCREASING ACTIVE AND PASSIVE WATER-ORIENTED AND PASSIVE LAND-ORIENTED OF THE OUTDOOR RECREATION PARTICIPATION RECREATIONAL USE OF OPEN SPACE PROVIDED BY THIS ALTERNATIVE WOULD BE BENEFICIAL LANDS AS OPEN SPACE, SCENIC ELEMENTS AND POSSIBLE RECREATIONAL AREAS. WITH 47% OCCURRING WITHIN THE ZERO TO ONE HOUR SCENIC ELEMENTS AND PRESERVATION OF FARM AND NATURAL RECREATIONAL DEMANDS.

DETRIMENTAL

STITUENT LOADS IN THE ESTUARY WILL EVENTUA-POLLUTANTS FROM THE ESTUARY AND SINCE CON-SINCE ITS OPERATING DISCHARGE WILL HAMPER LLY REACH 1975 LEVELS BY THE PROJECT YEAR THIS ALTERNATIVE'S EFFECTIVENESS IN CON-STREAM. IN FACT LAND TREATMENT MAY IN-MAGNITUDE OF IMPACT RESULTING FROM THE NATURAL PROCESSES IN FLUSHING IN-SITU 2000. THE TREATMENT PROCESS WILL NOT EFFECTIVELY REMOVE TDS FROM THE WASTE DISCHARGE OF HIGH TDS WATER WILL VARY TROLLING POLLUTANTS IS ONLY TEMPORARY WITH THE USE OF THE RECEIVING WATER. CREASE THE TDS OF RETURN WATER.

TERM ALTERATION DUE TO THE CONSTRUCTION AND UNDERDRAINS. LONG-TERM IMPACTS MAY COMPITMENT OF LAND TO TREATMENT FACILI-TIES AND THE POSSIBLE BUILD-UP OF HEAVY THE LAND WILL UNDERGO EXTENSIVE SHORT-AND PLACEMENT OF TREATMENT FACILITIES BE REALIZED IN THE CONVERSION OF WILD LAND TO MANAGED LAND, THE PERMANENT METALS IN THE SOIL.

CONDITIONS IN THE ALTHOUGH THIS ALTERNATIVE WOULD INITIALLY EASE ECOLOGICAL STRESS IN THE CRITICAL FLOWS APPROACH THE DESIGN CAPACITY OF THE COMMUNITIES TO MORE SALT TOLERANT SPECIES AREAS OF THE ESTUARY, ITS IMPACT OVER THE LONG-TERM ON THE CARRYING CAPACITY OF THE ESTUARY WOULD NOT BE SUSTAINING AS WASTE LAND AREAS WILL BE MODIFIED BY INCREASED TDS. THIS IMPACT WOULD BE CHARACTERIZED IN STREAMS WHERE TDS VALUES AND DILUTION STREAMS RECEIVING RETURN WATER FROM THE IMPACTS OF THIS ALTERNATIVE ON THE LAND DETRIMENTAL ECOLOGICAL BY A SHIFT IN THE AQUATIC AND RIPARIAN SAME AS THOSE EXPRESSED FOR AOUATIC UNIT PROCESSES. ALTERNATIVE B1. RATES ARE LOW.

CONSTRUCTION WILL CAUSE TEMPORARY VISUAL DEGRADATION OF EXISTING SYSTEM REQURIED LANDS. EVEN AFTER LANDSCAPING BUFFER. MAIN AN INTRUSIVE IMPACT OF MAN-MADE HAVE ACHIEVED MATURITY THERE MAY RE-ZONES AND OTHER MITIGATIVE MEASURES SYSTEMS IN THE NATURAL ENVIRONMENT, ALTHOUGH HISTORICAL SITES AND ARCHAEOLOGI-CAL SITES WILL BE PROTECTED BY BUFFER ZONES AND VEGETATION SCREENS SOME OF THEIR SIGNIFICANCE MAY BE LOST BY OBSTRUCTION OF SETTING.

THE PERMANENT COMMITMENT OF LAND TO TREAT-MENT FACILITIES COULD DEGRADE AND/OR DIS-PLACE THE CURRENT RECREATIONAL USE OF THE ACTIVE RECREATIONAL PURSUITS ON THE LAND SITES WILL BE LIMITED. CONSTRUCTION AND LAND.

<u>@</u> FIGURE

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(BENEFICIAL)

CHEMICAL/PHYSICAL FACTORS ECOLOGICAL ASSOCIATIONS AESTHETICS / CULTURAL

RECREATION

THIS ALTERNATIVE INCLUDES LAND AREA 27 IN MONTEREY COUNTY AND ENVISIONS THE INTER-BASIN TRANSFER OF WASTEWATER.

STITUENT LOADS ARE REDUCED PROPORTIONALLY MILPITAS - ALVISO AREA WOULD BE DIVERTED TO SITE 27 FOR LAND TREATMENT INSTEAD OF DISCHARGING TO SOUTH BAY AFTER TERTIARY OTHER CHEMICAL/PHYSICAL IMPACTS ARE THE DISCHARGE TO SOUTH BAY IS REDUCED, CON-SAME AS INDICATED FOR ALTERNATIVE B-1. TREATED WASTEWATER FROM THE SAN JOSE TREATMENT AS IN ALTERNATIVE B-1.

AND SOIL CONDITIONERS WILL ENHANCE AGRI-CULTURAL PRODUCTIVITY OF THE LAND AREAS. OPEN SPACE RESERVES WILL BE CREATED AND THE AVAILABILITY OF WATER, "FERTILIZER" MAINTAINED.

NATIVE B-1. IN ADDITION, BASED ON REDUCED PICATION PROGRAM ACCOMPANYING THE CONCONSTITUENT LOADS IN A HYDROLOGICALLY
NEGATIVE ESTUARY, AQUATIC CONDITIONS FOR STATIONS WILL ENHANCE THEIR VISUAL PROFILE, OF THE OUTDOOR RECREATION PARTICIPATION
SANTHLE AND OTHER LOWER FOOD CHAIN SPECIES SINCE PIPELINE ROUTES WILL HAVE TO REMAIN OCCURRING WITHIN THE ZERO TO ONE HOUR STRESSES (TOXICITY AND EUTROPHICATION) EX- TAINED AND IN GRAZING AREAS THE CHANGE IN PLANNING AND DEVELOPMENT IN THE APPLICATED ON THE BIOTIC COMMUNITIES OF CENTRAL VEGETATIVE COVER WOULD COMPLEMENT THE CATION SITES ARE DIRECTED TOWARD THE AND SUISUN BAYS AS INDICATED UNDER ALTER. SURROUNDING NATIVE COVER TYPE. THE BEAUTH PRESENTATION OF FARM AND NATIVEAL LANDS THIS ALTERNATIVE WILL REDUCE ENVIRONMENTAL TER OF THE AREA WOULD BE PERMANENTLY RE-WILL BE FURTHER IMPROVED IN SOUTH BAY BY REDUCED DISCHARGES.

OPEN FOR MAINTENANCE PURPOSES, A POTENTIAL POR GREEN BELTS IN URBAN AREAS EXISTS. CROP AREAS THE RURAL AGRICULTURAL CHARAC-OPEN SPACE AND OPEN WATER PRESERVES. IN THIS ALTERNATIVE WILL PROVIDE PERMANENT

IMPROVED WATER QUALITY IN THE ESTUARY AND INCREASED FLOW IN LOCAL STREAMS WILL EN-HANCE THE SENSORY VALUE OF THE REGION'S WATERWAYS.

NATIVE COULD INCREASE ACTIVE AND PASSIVE BY THIS ALTERNATIVE WOULD BE BENEFICIAL IN MEETING INCREASING ACTIVE AND PASSIVE WATER-ORIENTED AND PASSIVE LAND-ORIENTED TRAVEL ZONE FROM METROPOLITAN AREAS, THE RECREATIONAL USE OF OPEN SPACE PROVIDED WATER-ORIENTED RECREATIONAL ACTIVITIES BY IMPROVING WATER QUALITY THIS ALTER-ASSOCIATED WITH THE BAY-DELIA ESTUARY. RECREATIONAL DEMANDS.

(DETRIMENTAL)

THE MAGNITUDE OF IMPACT RESULTING FROM THE INCREASED SALINITY IN BOTH CASES WILL VARY WATER. ALTHOUGH REDUCED DISCHARGE TO THE MAY ALSO CONTRIBUTE TO INCREASED SALINITY SOUTH BAY REDUCES THE CONSTITUENT LOAD IT IDS FROM THE WASTE STREAM. IN FACT LAND TREATMENT MAY INCREASE THE TDS OF RETURN IN THIS HYDROLOGICAL NEGATIVE ESTUARY. THE TREATMENT PROCESSES (LAND AND FULL TERTIARY) WILL NOT EFFECTIVELY REMOVE USE OF THE RECEIVING WATER. WITH THE

AND PLACEMENT OF TREATMENT FACILITIES AND UNDERDRAINS. LONG-TERM IMPACTS MAY BE TO MANAGED LAND, THE PERMANENT COMMITMENT OF LAND TO TREATMENT FACILITIES AND THE POSSIBLE BUILD-UP OF HEAVY METALS IN THE REALIZED IN THE CONVERSION OF WILD LAND TERM ALTERATION DUE TO THE CONSTRUCTION THE LAND WILL UNDERGO EXTENSIVE SHORT-

AS INDICATED ABOVE THIS ALTERNATIVE IN-CLUDES LAND AREA 27 LOCATED IN MONTEREY COUNTY

SPECIES IN STREAMS WHERE TDS VALUES

AND DILUTION RATES ARE LOW.

COMMUNITIES TO MORE SALT TOLERANT

LOSS OR AVOIDANCE MIGRATION. POST CON-INDIGENOUS ANIMAL SPECIES DUE TO DIRECT CONSTRUCTION ON SYSTEM REQUIRED LANDS PLANNING HAS PROVIDED FOR RESTORATION OF NATIVE VEGETATION, RE-INHABITATION RETURN WATER FROM THE LAND AREAS WILL STRUCTION RECOVERY SUCCESS WILL VARY WITH THE NEW HABITAT TYPE. IN AREAS HAS OCCURRED DUE TO INCREASED MOISTURE WHERE A RADICAL CHANGE OF COVER TYPE NEW BIOTIC COMMUNITIES WILL DISPLACE THERE WILL BE NO RECOVERY. AQUATIC CONDITIONS IN THE STREAMS RECFIVING WILL BE SLOW AND IN INUNDATED AREAS WILL CAUSE AN INITIAL REDUCTION IN IMPACT WOULD BE CHARACTERIZED BY A THE EXISTING ONES. IN AREAS WHERE SHIFT IN THE ACUATIC AND RIPARIAN BE MODIFIED BY INCREASED TDS.

ZONES AND OTHER MITIGATIVE MEASURES HAVE CONSTRUCTION WILL CAUSE TEMPORARY VISUAL DEGRADATION OF EXISTING SYSTEM REQUIRED ACHIEVED MATURITY THERE MAY REMAIN AN LANDS. EVEN AFTER LANDSCAPING BUFFER INTRUSIVE IMPACT OF MAN-MADE SYSTEMS IN THE NATURAL ENVIRONMENT. ALTHOUGH HISTORICAL SITES AND ARCHAEOLOGI-THEIR SIGNIFICANCE MAY BE LOST BY OBSTRU-CAL SITES WILL BE PROTECTED BY BUFFER ZONES AND VEGETATION SCREENS SOME OF CTION OF SETTING.

THE PERMANENT COMMITMENT OF LAND TO TREAT MENT FACILITIES COULD DEGRADE AND/OR DIS-PLACE THE CURRENT RECREATIONAL USE OF THE ACTIVE RECREATIONAL PURSUITS ON THE LAND SITES WILL BE LIMITED, CONSTRUCTION AND

ENVIRONMENTAL EVALUATION - ALTERNATIVE D-1

BENEFICIAL)

CHEMICAL/PHYSICAL FACTORS ECOLOGICAL ASSOCIATIONS A ESTHETICS / CULTURAL

WITH THIS ALTERNATIVE THE GREATER USE OF LAND AREAS AS A TREATWENT PROCESS AND THE SUBSEQUENT REDUCTION IN THE NUMBER OF TERTIARY TREATMENT PLANT DISCHARGES WILL REDUCE CONSTITUENT LOADS IN THE BAY-DELTA REDUCE CONSTITUENT LOADS IN THE BAY-DELTA BY THE B-SERIES OF ALTERNATIVES. THERE WOULD BE NO DISCHARGE TO THE CENTRAL BAY OR SUISUN BAY AND ONLY 2 MGD OF TREATED WATER WOULD BE DISCHARGED IN THE DELTA. THIS GREATER REDUCTION IN POLLUTANT THIS GREATER REDUCTION IN POLLUTANT CADA IN THE ESTUARY WOULD AMPLIFY THE BENFICIAL IMPACTS RECORDED UNDER CHEMICAL/PHYSICAL FACTORS FOR ALTERNATIVE

THIS ALTERNATIVE WILL ALMOST ELIMINATE
THE ENVIRONMENTAL STRESS EXERTED ON THE
BIOTIC COMMUNITIES OF THE BAY-DELTA
ESTUARY BY MUNICIPAL AND INDUSTRIAL WASTES
IT WILL IMPACT MOST ON ACUTE TOXICITY
STRESS AS THE CONSTITUENTS RESPONSIBLE FOR
THIS STRESS ARE FOUND PRIMARILY WITHIN THE
MUNICIPAL AND INDUSTRIAL WASTE STREAM.
CHRONIC TOXICITY DUE TO BIO-ACCUMULATION
OF HAAVY METALS AND PESTICIDES WOULD ALSO
BE REDUCED. BIOSTIMULATION POTENTIAL
AND OREATLY CURBED IN THE SOUTH BAY
AND GREATLY CURBED IN THE SOUTH BAY
SUISUN BAY AND THE DELTA. THE BIOLOGICAL
RESPONSE TO THIS ALTERNATIVE, ALTHOUGH
BUFFERED BY OTHER WATER QUALITY AND
QUANTITY PROBLEMS, WOULD BE A SUSTAINED
INCREASE IN THE CARRYING CAPACITY OF
THE ESTUARY AND CONTIGUOUS WETLANDS.

THIS ALTERNATIVE WILL PROVIDE PERNAMENT
OPEN SPACE AND OPEN WATER PRESERVES. IN
CROP AREAS THE RURAL AGRICULTURAL CHARACTER OF THE AREA WOULD BE PERNAMENTLY RETAINED AND IN GRAZING AREAS THE CHANGE
IN VEGETATIVE COVER WOULD COMPLEMENT
THE SURROUNDING NATIVE COVER TYPE. THE
BEAUTIFICATION PROGRAM ACCOMPANYING THE
CONVERSION OF TREATMENT PLANTS TO PUMPING
STATIONS WILL ENHANCE THEIR VISUAL PROFILE. SINCE PIPELINE ROUTES WILL HAVE
FILE. AND PELLINE ROUTES WILL HAVE
TO REMAIN OPEN FOR MAINTENANCE PURPOSES,
A POTENTIAL FOR GREEN BELTS IN URBAN
AREAS EXISTS.

RECREATION

NATIVE COULD INCREASE ACTIVE AND PASSIVE TRAVEL ZONE FROM METROPOLITAN AREAS, THE BY THIS ALTERNATIVE WOULD BE BENEFICIAL IN MEETING INCREASING ACTIVE AND PASSIVE WATER-ORIENTED AND PASSIVE LAND-ORIENTED OF THE OUTDOOR RECREATION PARTICIPATION RECREATIONAL USE OF OPEN SPACE PROVIDED BY IMPROVING WATER QUALITY THIS ALTER-WATER-ORIENTED RECREATIONAL ACTIVITIES ASSOCIATED WITH THE BAY-DELTA ESTUARY. PLANNING AND DEVELOPMENT IN THE APPLI-PRESERVATION OF FARM AND NATURAL LANDS POSSIBLE RECREATIONAL AREAS. WITH 47% CATION SITES ARE DIRECTED TOWARD THE OCCURRING WITHIN THE ZERO TO ONE HOUR AS OPEN SPACE, SCENIC ELEMENTS AND RECREATIONAL DEMANDS.

(DETRIMENTAL)

THE TREATMENT PROCESSES (LAND AND FULL TERTIARY) WILL NOT FFECTIVELY REMOVE TDS FROM
THE WASTE STREAM. IN FACT, LAND TREALMENT
MAY INCREASE THE TDS OF RETURN WATER. THE
MAGNITUDE OF IMPACT RESULTING FROM THE DISCHARGE OF HIGH TDS WATER WILL VARY WITH
THE USE OF THE RECEIVING WATER. IN ADDITION
REDUCED WASTEWATER FLOW TO CENTRAL AND SUISUN
BAYS AND THE DELTA MAY ALTER THE FLUSHING
BASCHEN OF THE ESTIMRY, THUS INCREASING TDS
LEVELS IN ITS EXTREMITIES.

THE LAND WILL UNDERGO EXTENSIVE SHORT-TERM ALTERATION DUE TO THE CONSTRUCTION AND PLACEMENT OF TREATMENT FACILITIES AND UNDER-DRAINS. LONG-TERM IMPACTS MAY BE REALIZED IN THE CONVERSION OF WILD LAND TO MANAGED LAND, THE PERMANENT COMMITMENT OF LAND TO TREATMENT FACILITIES AND POSSIBLE BULLD-UP OF HEAVY METALS IN THE SOIL.

CONSTRUCTION ON SYSTEM REQUIRED LANDS WILL COMMUNITIES TO MORE SALT TOLERANT SPECIES AREAS WILL BE MODIFIED BY INCREASED TDS. CAUSE AN INITIAL REDUCTION IN INDIGENOUS IN STREAMS WHERE TDS VALUES AND DILUTION THIS IMPACT WOULD BE CHARACTERIZED BY A UNDATED AREAS THERE WILL BE NO RECOVERY. POST CONSTRUCTION CHANGE OF COVER TYPE HAS OCCURRED DUE TO INCREASED MOISTURE, NEW BIOTIC COMMUNITIES WILL DISPLACE THE EXISTING ONES. RECOVERY SUCCESS WILL VARY WITH THE NEW HABITAT TYPE. IN AREAS WHERE A RADICAL AREAS WHERE PLANNING HAS PROVIDED FOR RESTORATION OF NATIVE VEGETATION, RE-RECEIVING RETURN WATER FROM THE LAND ANIMAL SPECIES DUE TO DIRECT LOSS OR AVOIDANCE MIGRATION. POST CONSTRUCTI INHABITATION WILL BE SLOW AND IN IN-AQUATIC CONDITIONS IN THE STREAMS SHIFT IN THE AOUATIC. AND RIPARIAN

CONSTRUCTION WILL CAUSE TEMPORARY VISUAL DEGRADATION OF EXISTING SYSTEM REDUIRED LANDS. EVEN AFTER LANDSCAPING BUFFER ZONES AND OTHER MITIGATIVE MEASURES HAVE ACHIEVED MATURITY THERE MAY REMAIN AN INVENSIVE INPACT OF MAN-MADE SYSTEMS IN THE NATURAL ENVIRONMENT.

ALTHOUGH HISTORICAL SITES AND ARCHAEOLOGICAL SITES WILL BE PROTECTED BY BUFFER ZONES AND VEGETATION SCREENS SOME OF THEIR SIGNIFICANCE MAY BE LOST BY OBSTRUCTION OF SETTING.

ACTIVE RECREATIONAL PURSUITS ON THE LAND SITES WILL BE LIMITED. CONSTRUCTION AND THE PERNANENT COMMITMENT OF LAND TO TREATMENT FACILITIES COULD DECRADE AND/OR DISPLACE THE CURRENT RECREATIONAL USE OF THE LAND.

0-2 ENVIRONMENTAL EVALUATION-ALTERNATIVE

(BENEFICIAL)

CHEMICAL PHYSICAL FACTORS ECOLOGICAL ASSOCIATIONS A ESTHETICS CULTURAL

RECREATION

THE TREATMENT PROCESSES (LAND AND ADVANCED TREATMENT) IN THIS ALTERNATIVE LIMIT MASS EMISSION OF CONSTITUENTS TO TOTALS WHICH DONOT EXCEED THOSE OF THE BASE CONDITION. ALTHOUGH THE TREATMENT PLANT COMPONENT IS NOT AS EFFICIENT AS TERTIARY TREATMENT, THE INCREASED USE OF LAND TREATMENT ALLOWING NO DISCHARGE TO SUISUM BAY AND THE CENTRAL BAY AND REDUCED FLOWS IN THE DELTA REDUCES OVERALL CONSTITUENT LOADS IN THE ESTUARY TO LEVELS BELOW THOSE OF ALTERMANTED B-2.

OF INCREASES IN FLOW, INITIALLY THE TREATMENT PRECESSES FOULD REDUCE TOXICITY, WATERS, HOWEVER, AS WASTE FLOWS INCREASE AND FLUSHING FLOWS DECREASE, AS EXPECTED: IN THE PUTURE, THE CONSTITUENTS RESPONSI-POLLUTANT CONCENTRATIONS IN THE RECEIVING LEAST STABALIZED AT 1975 LEVELS IN SPITE INDER THIS ALTERNATIVE ECOLOGICAL STRESS INDUSTRIAL WASTE DISCHARGES WOULD BE AT EUTROPHICATION POTENTIAL AND PERSISTANT YEAR 2000 THEIR LOADS WOULD AGAIN BE AT RESPONSE TO IMPROVED HABITAT CONDITIONS BLE FOR THESE PROBLEMS WOTTLD GRADUALLY ARE CURRENTLY EXPERIENCING ACUTE WATER 1975 LEVELS. THE IMMEDIATE BIOLOGICAL CAPACITY OF AREAS IN THE ESTUARY THAT WOULD BE AN INCREASE IN THE CARRYING IN THE ESTUARY DUE TO MUNICIPAL AND INCREASE TO A POINT WHERE BY PROJECT MALITY DEGRADATION.

THIS ALTERNATIVE WILL PROVIDE PERMANENT
SPACE AND OPEN WATER PRESERVES. IN CROP
AREAS THE RURAL AGRICULTURAL CHARACTER OF
THE AREA WOULD BE PERMATENTLY RETAINED AND
IN CRAZING AREAS THE CHANGE IN VEGETATIVE
COVER WOULD COMPLEMENT THE SURROUNDING
NATIVE COVER TYPE. THE BEAUTIFICATION
PROGRAM ACCOMPANYING THE CONVERSION OF
TREATMENT PLANTS TO PUMPING STATIONS WILL
ENHANCE THEIR VISUAL PROFILE. SINCE PIPELINE ROUTES WILL HAVE TO REMAIN OPEN FOR
MAINTENANCE PURPOSES, A POTENTIAL FOR
GREEN BELTS IN URBAN ARRAS EXISTS.

IMPROVED WATER QUALITY IN THE ESTUARY AND INCREASED FLOW IN LOCAL STREAMS WILL EN-HANCE THE SENSORY VALUE OF THE REGION'S WATERWAYS.

BY IMPROVING WATER QUALITY THIS ALTERNATIVE COULD INCREASE ACTIVE AND PASSIVE WATER-ORIENTED RECREATIONAL ACTIVITIES ASSOCIATED WITH THE BAY-DELTA ESTUARY. PLANNING AND DEVELOPMENT IN THE APPLICATION SITES ARE DIRECTED TOWARD THE PRESERVATION OF FARM AND NATURAL LANDS AS OPEN SPACE, SCENIC ELEMENTS AND POSSIBLE RECREATIONAL AREAS, WITH 47% OF THE OUTDOOR RECREATION PARTICIPATION OCCURRING WITHIN THE ZERO TO ONE HOUR TRAVEL ZONE FROM METROPOLITAN AREAS, THE RECREATIONAL USE OF OPEN SPACE PROVIDED BY THIS ALTERNATIVE WOULD BE BENEFICIAL IN MEETING INCREASING ACTIVE AND PASSIVE WATER-ORIENTED AND PASSIVE LAND-ORIENTED RECREATIONAL DEMANDS.

(DETRIMENTAL)

THUS INCREASING TDS LEVELS IN ITS EXTREMITIES. COMMITMENT OF LAND TO TREATMENT FACILITIES WASTE STREAM. IN FACT LAND TREATMENT MAY CENTRAL AND SUISUN BAYS AND THE DELTA MAY AND THE POSSIBLE BUILD-UP OF HEAVY METALS ALTER THE FLUSHING REGIMEN OF THE ESTUARY WITH THE USE OF THE RECEIVING WATER, IN THIS ALTERNATIVE'S EFFECTIVENESS IN CON-SINCE ITS OPERATING DISCHARGE WILL ALLOW EVENTUALLY REACH 1975 LEVELS BY THE PRO-WILL NOT EFFECTIVELY REMOVE TDS FROM THE TERM ALTERATION DUE TO THE CONSTRUCTION LONG-TERM IMPACTS MAY THE LAND WILL UNDERGO EXTENSIVE SHORT-JECT YEAR 2000. THE TREATMENT PROCESS MAGNITUDE OF IMPACT RESULTING FROM THE HIGH IDS WATER WILL VARY BE REALIZED IN THE CONVERSION OF WILD TROLLING POLLUTANTS IS ONLY TEMPORARY AND PLACEMENT OF TREATMENT FACILITIES ADDITION, REDUCED WASTEWATER FLOW TO CONSTITUENT LOADS IN THE ESTUARY TO LAND TO MANAGED LAND, THE PERMANENT INCREASE THE IDS OF RETURN WATER. AND UNDERDRAINS. DISCHARGE OF

ALTHOUGH THIS ALTERNATIVE WOULD INITIALLY EASE ECOLOGITAL STRESS IN THE CRITICAL AREAS OF THE ESTUARY, ITS IMPACT OVER THE LONG-TERM ON THE CARRYING CAPACITY OF THE ESTUARY WOULD NOT BE SUSTAINING AS WASTERLOWS APPRRACH THE DESIGN CAPACITY OF THE UNIT PROCESSES, AQUATIC CONDITIONS IN THE IAND AREAS WILL BE MODIFIED BY INCREASED TDS. THIS IMPACT WOULD BE CHARACTERIZED BY A SHIFT IN THE AQUATIC AND SPECIES IN STREAMS WHERE TDS VALUES AND DILUTION RATES ARE LOW, DETRIMENTAL ECOLOGICAL IMPACTS OF THIS ALTERNATIVE ON THE LAND ARE THE SAME AS THOSE EXPRESSED FOR ALTERNATIVE DOLTHER AND THE LAND ARE THE SAME AS THOSE EXPRESSED FOR ALTERNATIVE DOLTHER

CONSTRUCTION WILL CAUSE TEMPORARY VISUAL DEGRADATION OF EXISTING SYSTEM REQUIRED LANDS. EVEN AFTER LANDSCAPING, BUFFER ZONES AND OTHER MITIGATIVE MEASURES HAVE ACHIEVED MATURITY THERE MAY REMAIN AN INTRISIVE IMPACT OF MAN-MADE SYSTEMS IN THE NATURAL ENVIRONMENT.

ALTHOUGH HISTORICAL SITES AND ARCHAEOLOGI-CAL SITES WILL BE PROTECTED BY BUFFER ZONES AND VEGETATION SCREENS SOME OF THEIR SIGNIFICANCE MAY BE LOST BY OBSTRUCTION OF SETTING.

ACTIVE RECREATIONAL PURSUITS ON THE LAND SITES WILL BE LIMITED. CONSTRUCTION AND THE PERMANENT COMMITMENT OF LAND TO TREATMENT FACILITIES COULD DEGRADE AND/OR DISPLACE THE CURRENT RECREATIONAL USE OF THE LAND.

ENVIRONMENTAL EVALUATION -ALTERNATIVE D-

BENEFICIAL)

RECREATION

CHEMICAL/PHYSICAL FACTORS ECOLOGICAL ASSOCIATIONS AESTHETICS CULTURAL

THIS ALTERNATIVE, LIKE ALTERNATIVE B-3, INCLUDES LAND AREA 27 IN MONTEREY COUNTY AND
ENVISIONS THE INTERBASIN TRANSFER OF WASTEWATER FROM THE SAN JOSE - MILPITAS - ALVISO
AREA. AS A RESULT, LESS FLOW, HENCE LESS
CONSTITUENTS, WILL ENTER THE SOUTH BAY AND
PACIFIC OCEAN. OVERALL, THE COMBINATION
OF TERTIARY TREATMENT AND MAXIMUM USE OF
THE LAND AREAS AS A TREATMENT PROCESS REDUCES CONSTITUENT LOADS IN ALL WATER QUALITY
ZONES OF THE ESTUARY TO LEVELS APPROACHING
ZENO DISCHARGE.

INCLUDING THAT OF BIOACCUMULATION OF PESTICIDES AND HEAVY METALS, WOLLD BE AT MINIMUM LEVELS. THE PROBLEM OF REDUCED OR FLUCTUATING DISSOLVED OXYGEN LEVELS RESULTING FROM EUTROPHICATION OR HIGH ORGANIC WASTE LOADS WOULD BE AS A RESULT, STITUENT LOAD AND ENVIRONMENTAL STRESS WITH A PHYSICAL ENVIRONMENT RELATIVELY FREE OF MUNICIPAL AND INDUSTRIAL WASTE BASED ON THE RELATIONSHIP BETWEEN CON-TIVE AREAS OF THE ESTUARY AND LIMITED MINIMIZED IN THE BIOLOGICALLY SENSI-ONLY BY FRESHWATER OUTFLOW AND ACRI-RATES OF FISHES AND LOWER FOOD CHAIN REPRODUCTION NO GROWTH AND SURVIVAL SPECIES AND OTHER ASSOCIATED SPECIES CHLORINE TOXICITY, CHRONIC TOXICITY STRESS. ACUTE TOXICITY, INCLUDING SPECIES WOULD BE SIGNIFICANTLY EN-THIS ALTERNATIVE PROVIDES AQUATIC CULTURAL WASTE DISCHARGE.

THIS ALTERNATIVE WILL PROVIDE PERMANENT OPEN SPACE AND OPEN WATER PRESERVES. IN CROP AREAS THE RURAL AGRICULTURAL CHARACTER OF THE AREA WOULD BE PERMANENTLY RETAINED AND IN GRAZING AREAS THE CHANGE IN VEGETATIVE COVER WOULD COMPLEMENT THE SURROUNDING NATIVE COVER TYPE. THE BEAUTIFICATION PROGRAM ACCOMPANYING THE CONVERSION OF TREATMENT PLANTS TO PUMPING STATIONS WILL ENHANCE THEIR VISTAL PROFILE. SINCE PIPELINE ROUTES WILL HAVE FILE. SINCE PIPELINE ROUTES WILL HAVE FILE. SINCE PIPELINE ROUTES WILL HAVE AND REMAIN OPEN FOR MAINTENANCE PURPOSES, A POTENTIAL FOR GREEN BELTS IN URBAN

IMPROVED WATER QUALITY IN THE ESTUARY
AND INCREASED FLOW IN LOCAL STREAMS
WILL ENHANCE THE SENSORY VALUE OF THE
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BY IMPROVING WATER QUALITY THIS ALIER-NATIVE COULD INCREASE ACTIVE AND PASSIVE WATER-ORIENTED RECREATIONAL ACTIVITIES ASSOCIATED WITH THE BAY-DELTA ESTRARY. PLANNING AND DEVELOPMENT IN THE APPLICATION SITES ARE DIRECTED TOWARD THE PRESERVATION OF FARM AND NATURAL LANDS AS OPEN SPACE, SCENIC ELEMENTS AND POSSIBLE RECREATIONAL AREAS, WITH 47% OF THE OUTDOOR RECREATION PARTICIPATION OCCURRING WITHIN THE ZERO TO ONE HOUR IRAVEL ZONE FROM METROPOLITAN AREAS, THE RECREATIONAL USE OF OFREN SPACE PROVIDED BY THIS ALIERNATIVE WOULD BE BENEFICIAL IN METRING INCREASING ACTIVE AND PASSIVE MATER-ORIENTED AND PASSIVE LAND-ORIENTED RECREATIONAL DEMANDS,

(DETRIMENTAL)

THE TREATMENT PROCESSES (LAND AND FULL TERTIARY) WILL NOT EFFECTIVELY REMOVE TOS FROM THE WASTE STREAM. IN FACT, LAND TREATMENT MAY INCREASE THE TOS OF RETURN WATER. THE MAGNITUDE OF IMPACT RESULTING FROM THE DISCHARGE OF HIGH TOS WATER WILL VARY WITH THE USE OF THE RECEIVING WATER. IN ADDITION REDUCED WASTEWATER FLOW TO CENTRAL AND SUISUN BAYS MAY ALLER THE FLUSHING REGIMEN OF THE ESTUARY THUS INCREASING TOS LEVEL, IN ITS EXTREMITIES.

THE LAND WILL UNDERGO EXTENSIVE SHORTTERM ALTERATION DUE TO THE CONSTRUCTION
AND PLACEMENT OF TREATMENT FACILITIES AND
UNDERRAINS. LONG-TERM INFACTS MAY BE
REALIZED IN THE CONVERSION OF WILD LAND
TO MANAGED LAND, THE PERMANENT COMMITMENT
OF LAND TO TREATMENT FACILITIES AND THE
POSSIBLE BUILD-UP OF HEAVY METALS IN THE
SOLL.

NHABITATION WILL BE SLOW AND IN INUNDATED CONSTRUCTION ON SYSTEM REQUIRED LANDS WILL CAUSE AN INITIAL REDUCTION IN INDIGENOUS AREAS THERE WILL BE NO RECOVERY, AOUATIC PACT WOULD BE CHARACTERIZED BY A-SHIFT IN TIES WILL DISPLACE THE EXISTING ONES. IN AREAS WHERE PLANNING HAS PROVIDED FOR AVOIDANCE MIGRATION. POST CONSTRUCTION RECOVERY SUCCESS WILL VARY WITH THE NEW HABITAT TYPE. IN AREAS WHERE A RADICAL CHANGE OF COVER TYPE HAS OCCURRED DUE TO INCREASED MOISTURE, NEW BIOTIC COMMUNI-THE AQUATIC AND RIPARIAN COMMUNITIES TO MERE SALT TOLERANT SPECIES IN STREAMS WHERE TDS VALUES AND DILUTION RATES ARE THIS IM-RESTORATION OF NATIVE VEGETATION, RE-RETURN WATER FROM THE LAND AREAS WILL ANTMAL SPECIES DUE TO DIRECT LOSS OR IS THE STREAMS RECEIVING BE MODIFIED BY INCREASED TDS.

CONSTRUCTION WILL CAUSE TEMPORARY VISUAL DEGRADATION OF EXISTING SYSTEM REQUIRED LANDS. EVEN AFTER LANDSCAFING BUFFER ZONES AND OTHER MITIGATIVE MEASURES HAVE ACHIEUED MATURITY THERE MAY REMAIN AN INTRUSTUE INPACT OF MAN-MADE SYSTEMS IN THE NATURAL ENVIRONMENT.

ALTHOUGH HISTORICAL SITES AND ARCHAEOLOGI-CAL SITES WILL BE PROTECTED BY BUFFER ZONES AND VEGETATION SCREENS SOME OF THEIR SIGNIFICANCE MAY BE LOST BY OB-STRUCTION OF SETTING.

ACTIVE RECREATIONAL PURSUITS ON THE LAND SITES WILL BE LIMITED, CONSTRUCTION AND THE PERMANENT COMMITMENT OF LAND TO TREATMENT FACILITIES COULD DEGRADE AND/OR DISPIACE THE CURRENT RECREATIONAL USE OF THE LAND.

1-8	PUBLIC HEALTH	THE TREATMENT PLANT COMPONENT APPLIES THE BEST PRACTICABLE TREATMENT TECH- NOLOGY FOR REMOVAL OF TOXIC CHEMICALS. AS A RESULT OF THE LAND TREATMENT COMPONENT OF THE ALTERNATIVE THERE WOULD BE AN OVERALL REDUCTION IN THE NUMBER OF WATERBORNE PATHOGENS ENTERING THE ESTHARY UNDER NORMAL OPERATING CONDITIONS, GREATER CONTROL OF WATERBORNE PATHOGENS IN BETREGENCY CONDITIONS, A REDUCTION IN THE OVER- ALL DISCHARGE OF TOXIC CHEMICALS AND A REDUCTION IN CHLORINE TOXICITY IN THE ESTUARY. THE SIGNIFICANT RE- DUCTION OF TOXIC CHEMICALS IN THE RE- CEIVING WATER WOULD AID NATURAL PROCESSES IN FLUSHING TOXICANTS FROM ESTUARINE SEDIMENTS.		THE APPLICATION OF WASTEWATER TO LAND WILL INCREASE ARTHROPOD AND VERTEBRATE NUISANCE ANIMALS ASSOCIATED WITH WETLANDS. WITH PROPER WATER MANAGEMENT AND ABATEMENT MEASURES THE MAGNITUDE OF THIS INCREASE WILL BE EQUAL TO THAT OF A NORMAL IRRICATION PROJECT. SINCE HABITAT, VECTORS, HOSTS AND AGENTS WILL BE PRESENT IN THE APPLICATION AREAS, A POTENTIAL FOR ZOONOTIC DISEASE TRANSMISSION WILL EXIST. THE RISK FACTOR WILL DEPEND ON HUMAN EXPOSURE AND VECTOR CONTROL.
N -ALTERNATIVE	DISTRIBUTIVE EQUITY	30 MILLION MAN DAYS OF TOTAL CONSTRUCTION EMPLOYMENT; \$1,749 MILLION TOTAL WAGES, \$287 MILLION OF WHICH IS MINORITY SHARE. 7,000- 9,000 EMPLOYMENT PORCE FOR SYSTEM O&M, WITH TOTAL ANNUAL WAGES OF \$143 MILLION. OPPORTUNITY FOR IN- CREASED SHARE OF MINORITY WORKERS IN JOB TRAINING, HIGHER JOB LEVELS, JOB PARTICIPATION, AND JOB INCOME FOR BOTH CONSTRUCTION AND O&M PHASES.	ENTAL)	NOT APPLICABLE
SOCIAL EVALUATION -ALTERNATIVE B-1	PUBLIC ATTITUDES	ASSURANCE OF MEETING ADEQUATE WASTEWATER QUALITY STANDADS. POSITIVE REACTION TO ASSURANCE OF SYSTEM TO HELP RETAIN OPEN SPACE USES ON SITES AND ENVIRONMENTAL ENHANCEMENT OF POTENTIAL PARKS, OPEN SPACE, AND RESERVOIRS. SOME EXPRESSION OF AGRICULTURAL BENEFITS FROM OFFICALS AND INDIVIDUALS IN SAN JOAQUIN, MARIN AND NAPA COUNTIES.	(DETRIMENTAL	CONCERN OF SYSTEM EFFECT TO POSSIBLY IN- FLUENCE INCREASED URBANIZATION, ENVIRON- MENNAL IMPAIRMENT, CHANGE OF LIFE-STYLE, CHANGE OF FARM OPERATION AND INCOME, DISRUPTION OF RESIDENT JOBS AND HOUSING AND WASTERATER NUISANCES. INCONVENIENCE OF PATRONS, SERVICE USERS, AND RESIDENTS DURING CONSTRUCTION PHASES. ANXIETY OVER POSSIBLE LOSS OF SOCIAL STRUCTURE AND COHESION AMONG SOME ETHNIC GROUPS. CONCERN OF BUSINESS AND SERVICE ESTAB- LISHMENTS OVER ACCESS DISRUPTION.
S	AREA VIABILITY	THIS ALTERNATIVE HELPS IMPLEMENT LAND USE AND DEVELOPMENT PATTERN POLICIES. HELPS RETAIN RURAL, AGRICULTURAL LIFE- STYLE OF RESIDENTS OF SITES, AND EN- HANGES NEIGHBORHOOD COHESION WITH PARKS AND OPEN SPACES OF PIPELINE ROUTES IN URBAN CORES. 154,000 ACRES OF LAND WITHIN SEVEN SITES ASSURED OF RE- TENTION AS OPEN SPACE USES. POTENTIAL ORCHARD REPLACEMENT IN SLUDGE AREAS OF 5,900 ACRES RESULT IN ANNUAL INCOME GAIN OF \$1,140,000.		NET AVERAGE ANNUAL AGRICULTURAL INCOME LOSS FROM 35,800 ACRES OF CROP CHANGES. POTENTIAL AGRICULTURAL JOB DISRUPTION FOR 780 WORKERS AND LABOR INCOME LOSS OF \$1,520,000 PER CROP CYCLE DUE TO CROP CHANGES. NUISANCE OF DIRT, DUST, NOISE AND ACCESS DISRUPTION DURING CONSTRUCTION PHASE MAY CAUSE POSSIBLE BUSINESS AND SERVICE ESTABLISHMENT LOSSES. POTENTIAL ALTER- ATION OF JOB DEMAND FOR AGRICULTURAL MIGRANT WORKERS.

-2	PUBLIC HEALTH	THE TREATMENT PLANT COMPONENT APPROACHES THE BEST PRACTICABLE TREATMENT TECHNO- LOGY FOR REMOVAL OF TOXIC CHEMICALS, THE LAND TREATMENT COMPONENT WOULD PATHOGENE THE NUMBER OF WATERBORNE PATHOGENS ENTERING THE ESTRARY UNDER NORMAL OPERATING CONDITIONS, GREATER CONTROL OF WATERBORNE PATHOGENS IN EMER- GENCY CONDITIONS, A REDUCTION IN THE OVERALL DISCHARGE OF TOXIC CHEMICALS AND A REDUCTION IN CHLORINE TOXICITY IN THE ESTUARY, THE INITIAL REDUCTION OF TOXIC CHEMICALS IN THE RECEIVING WATER WOULD TEMPORARILY AID NATURAL PROCESSES IN FLUSHING TOXICANTS FROM ESTUARINE SEDIMENTS.		ALTHOUGH THE TREATMENT PLANT COM- PONENT WILL REDUCE TOXIC CHEMICALS TO LEVELS BELOW BASE LEVELS IT WILL NOT MAINTAIN THOSE LEVELS PAST 2000. THE APPLICATION OF WASTEWATER TO LAND WILL INCREASE ARTHROPOD AND VERTEBRATE NUISANCE ANIMALS ASSOCIATED WITH WET- LANDS. WITH PROPER WATER MANGEMENT AND ABATEMENT MEASURES THE MACNITUDE OF THIS INCREASE WILL BE EQUAL TO THAT OF A NORMAL IRRIGATION PROJECT. SINCE HABITAT, VECTORS, HOSTS AND ACENTS WILL BE PRESENT IN THE APPLICATION AREAS, A POTENTIAL FOR ZOONOTIC DISEASE TRANS- MISSION WILL EXIST. THE RISK FACTOR WILL DEPEND ON HUMAN EXPOSURE AND
N-ALTERNATIVE B	DISTRIBUTIVE EQUITY	24 MILLION MAN DAYS OF TOTAL CONSTRUCTION EMPLOYMENT; \$1,380 MILLION TOTAL WAGES, \$221 MILLION OF WHICH IS MINNETY SHARE. 7,000 = 9,000 EMPLOYMENT FORCE FOR SYSTEM OGM, WITH TOTAL ANNUAL WAGES OF \$121 MILLION. OPPORTUNITY FOR INCREASED SHARE OF MINORITY WORKERS IN JOB TRAINING, AND JOB INCOME FOR BOTH CONSTRUCTION AND OGM PHASES.	ENTAL)	NOT APPLICABLE
SOCIAL EVALUATION - ALTERNATIVE B-2 (BENEFICIAL)	PUBLIC ATTITUDES	ASSURANCE OF MEETING ADEQUATE WASTEWATER QUALITY STANDARDS. POSITIVE REACTION TO ASSURANCE OF SYSTEM TO HELP RETAIN OPEN SPACE USES ON SITES AND ENVIRONMENTAL ENHANCEMENT OF POTENTIAL PARKS, OPEN SPACE, AND RESERVOIRS. SOME EXPRESSION OF AGRICULTURAL BENEFITS FROM OFFICIALS AND INDIVIDUALS IN SAN JOAQUIN, MARIN AND NAPA COUNTIES.	(DETRIMENTAL	CONCERN OF SYSTEM FFFECT TO POSSIBLY INFLUENCE INCREASED URBANIZATION, ENVIRON-MENTAL IMPAIRMENT, CHANGE OF LIFE-STYLE, CHANGE OF FARM OPERATION AND INCOME, DISHUPTION OF RESIDENT JOBS AND HOUSING AND WASTEWATER NUISANCES, INCONVENIENCE OF PATRONS, SERVICE USERS, AND RESIDENTS POSSIBLE LOSS OF SOCIAL STRUCTURE AND COHESION AMONG SOME ETHNIC GROUPS, CONCRENO OVER ACCESS DISRUPTION.
<i>y</i>	AREA VIABILITY	THIS ALTERNATIVE HELPS IMPLEMENT LAND USE AND DEVELOPMENT PATTERN POLICIES. HELPS RETAIN RUBAL, AGRICULTURAL LIFE-STALE OF RESIDENTS OF SITES, AND ENHANCES NEIGHBORHOOD COHESION WITH PARKS AND OPEN SPACES OF PIPELINE ROUTES IN URBAN CORES. 153,000 ACRES OF LAND WITHIN SEVEN SITES ASSURED OF RETENTION AS OPEN SPACE USES. POTENTIAL ORCHARD REPLACEMENT IN SLUDGE AREAS OF 5,900 ACRES RESULT IN ANNUAL INCOME GAIN OF \$1,140,000.		NET AVERAGE ANNUAL INCOME LOSS FROM 35,800 ACRES OF CROP CHANGES. POTENTIAL AGRICULTURAL JOB DISRUPTION FOR 780 WORKERS AND LABOR INCOME LOSS OF \$1,520,000 PER CROP CYCLE DUE TO CROP CHANGES. NUTSANCE OF DIRT, DUST, NOISE AND ACCESS DISRUPTION DURING CONSTRUCTION PHASE MAY CAUSE POSSIBLE BUSINESS AND SERVICE ESTABLISHMENT LOSSES. POTENTIAL ALTERATION OF JOB DEMAND FOR AGRICULTURAL MIGRANT OR

8-3	PUBLIC HEALTH	THE TREATMENT PLANT COMPOMENT APPLIES THE BEST PRACTICABLE TREATMENT TECHNOLOGY FOR REMOVAL OF TOXIC CHEMICALS. AS A RESULT OF THE LAND TREATMENT COMPONENT OF THE ALTERNATIVE THERE WOULD BE AN OVERALL REDUCTION IN THE NUMBER OF WATERBORNE PATHOGENS ENTERING THE ESTUARY UNDER NORMAL OPERATING CONDITIONS, GREATER CONTROL OF WATERBORNE PATHOGENS IN EMERGENCY CONDITIONS, A REDUCTION IN THE OVERALL DISCHARGE OF TOXIC CHEMICALS AND A REDUCTION IN CHEMICALS AND A REDUCTION IN CHEMICALS THE SIGNIFICANT REDUCTION OF TOXIC CHEMICALS IF THE RECEIVING AATER WOULD AID NATURAL PROCESSES IN FLUSHING TOXICANTS FROM ESTUARINE SEDIMENTS. THIS ALTERNATIVE PROVIDES THE LOWEST DISCHARGE OF TOXIC CHEMICALS TO THE SOUTH BAY OF THE B-SERIES ALTERNATIVES.		
N-ALTERNATIVE	(BENEFICIAL) UDES DISTRIBUTIVE EQUITY	35 MILLION MAN DAYS OF TOTAL CONSTRUCTION EMPLOYMENT; \$2,001 MILLION TOTAL WAGES, \$320 MILLION OF WHICH IS MINORITY SHARE. 7,000 - 9,000 EMPLOYMENT FORCE FOR SYSTEM OSM, WITH TOTAL ANNUAL WAGES OF \$151 MILLION. OPPORTUNITY FOR INCREASED SHARE OF MINORITY WORKERS IN JOB TRAINING, HIGHER JOB LEVELS, JOB PARTICIPATION, AND JOB INCOME FOR BOTH CONSTRUCTION AND O&M PHASES.	(DETRIMENTAL)	
SOCIAL EVALUATION - ALTERNATIVE B-3	BUBLIC ATTITUDES	ASSURANCE OF MEETING ADEQUATE WASTEWATER QUALITY STANDARDS. POSITIVE REACTION TO ASSURANCE OF SYSTEM TO HELP RETAIN OPEN SPACE USES ON SITES AND ENVIRONMENTAL ENHANCEMENT OF POTENTIAL PARKS, OPEN SPACE, AND RESERVOIRS. SOME EXPRESSION OF AGRICULTURAL BENEFITS FROM OFFICIALS AND INDIVIDUALS IN SAN JOAQUIN, MARIN AND NAPA COUNTIES.	(DETRIM	
S	AREA VIABILITY	THIS ALTERNATIVE HELPS IMPLEMENT LAND USE AND DEVELOPMENT PATTERN POLICIES. HELPS RETAIN RURAL, ACRICULTURAL LIFE-STYLE OF RESIDENTS OF SITES, AND ENHANCES NEIGHBORHOOD COHESION WITH PARKS AND OPEN SPACES OF PIPE-LINE ROUTES IN URBAN CORES. 194,000 ACRES OF LAND WITHIN EIGHT SITES ASSURED OF RETENTION AS OPEN SPACE USES. POTENTIAL ORCHARD REPLACEMENT IN SLUDGE AREAS OF 6,100 ACRES RESULT IN ANNUAL INCOME GAIN OF		

NET AVERAGE ANNUAL INCOME LOSS FROM 50,900 ACRES OF CROP CHANGES.
POTENTIAL AGRICULTURAL JOB DISRUPTION FOR 900 WORKERS AND LABOR
INCOME LOSS OF \$1,900,000 PER CROP
CYCLE DUE TO CROP CHANGES. NUISANCE
OF DIRT, DUST, NOISE AND ACCESS DISRUPTION DUBING CONSTRUCTION PHASE
MAY CAUSE POSSIBLE BUSINESS AND
SERVICE ESTABLISHMENT LOSSES. POTENTIAL ALTERATION OF JOB DEMAND FOR AGRICULTURAL MIGRANT WORKERS.

CONCERN OF SYSTEM EFFECT TO POSSIBLY INFLUENCE INCREASED URBANIZATION, ENVIRONMENTAL IMPAIRMENT, CHANGE OF LIFE-STYLE,
CHANGE OF FARM OFFRATION AND INCOME,
DISRUPTION OF RESIDENT JOBS AND HOUSING
AND WASTEWATER NUISANCES, INCONVENIENCE
OF PATRONS, SERVICE USERS, AND RESIDENTS
DURING CONTRUCTION PHASES. ANXIETY
OVER POSSIBLE LOSS OF SOCIAL STRUCTURE
AND COHESION AMONG SOME ETHNIC GROUPS.
CONCERN OF BUSINESS AND SERVICE ESTABLISHMENTS OVER ACCESS DISRUPTION, OPPOSITION TO THE INTERBASIN TRANSFER OF TREATED
WASTEMATER.

THE APPLICATION OF WASTEWATER TO LAND WILL INCREASE ARTHROPOD AND VERTERRATE NUTSANCE ANIMALS ASSOCIATED WITH WETLANDS. WITH PROPER WATER MANGEMENT AND ABATEMENT MEASURES THE MAGNITUDE OF THIS INCREASE WILL BE EQUAL TO THAT OF A NORMAL IRRIGATION PROJECT. SINCE HABITAT, VECTORS, HOSTS AND AGENTS WILL BE PRESENT IN THE APPLICATION AREAS A POTENTIAL FOR ZOONOTIC DISPASE TRANSMISSING WILL EXIST, THE RISK FACTOR WILL DEPEND ON HUMAN EXPOSURE AND VECTOR CONTROL. THIS ALTERNATIVE WILL BRING THESE IMPACTS TO LAND AREA 27.

NOT APPLICABLE

I - Q	PUBLIC HEALTH	THE TREATMENT PLANT COMPONENT APPLIES THE BEST PRACTICABLE TREATMENT TECHNOLOGY FOR REMOVAL OF TOXIC CHEMICALS. AS A RESULT OF THE LAND TREATMENT COMPONENT OF THE ALTERNATIVE THERE WOULD BE AN OVERALL REDUCTION IN THE NUMBER OF WATERBORNE PATHOGENS ENTERING THE ESTLARY INDER NORMAL OPERATING CONDITIONS, GREATER CONTROL OF WATER- BORNE PATHOGENS IN EMERGENCY CONDITIONS, A REDUCTION IN THE OVERALL DISCHARGE OF TOXIC CHEMICALS AND A REDUCTION IN CHLORINE TOXICITY IN THE ESTUARY. THE SIGNIFICANT REDUCTION OF TOXIC CHEMICALS IN THE RECEIVING NATER WOULD AID NATURAL FROCESSES IN FLUSHING TOXICANTS FROM ESTUARINE SEDIMENTS. THIS ALTERNATIVE PROVIDES FOR NO DISCHARGE OF HEAVY METALS INTO THE CENTRAL BAY AND SUISUN BAY AND ONLY SMALL AMOUNTS (50 1bs/day) INTO THE DELTA.		
JATION -ALTERNATIVE	PUBLIC ATTITUDES DISTRIBUTIVE EQUITY	36 MILLION MAN DAYS OF TOTAL CONSTRUCTION EMPLOYMENT; \$2,070 MILLION TOTAL WAGES, \$331 MILLION OF WHICH IS MINORITY SHARE. 7,000 - 9,000 EMPLOYMENT PORCE FOR SYSTEM O.W. WITH TOTAL ANNUAL WAGES OF \$129 MILLION. OPPORTUNITY FOR INCREASED SHARE OF MINORITY WORKERS IN JOB TRAINING, HIGHER JOB LEVELS, JOB PARTICIPATION, AND JOB INCOME FOR BOTH CONSTRUCTION AND O.M. PHASES.	(DETRIMENTAL)	
SOCIAL EVALUATION -ALTERNATIVE D-1	PUBLIC ATTITUDES	ASSURANCE OF MEETING ADEQUATE WASTEWATER QUALITY STANDARDS. POSITIVE REACTION TO ASSUBANCE OF SYSTEM TO HELP RETAIN OPEN SPACE USES ON SITES AND ENVIRONMENTAL ENHANCEMENT OF POTENTIAL PARKS, OPEN SPACE, AND RESERVOIRS. SOME EXPRESSION OF AGRICULTURAL BENEFITS FROM OFFICIAL AND INDIVIDUALS IN SAN JOAQUIN, MARIN AND NAPA COUNTIES.	(DETRIM	
	AREA VIABILITY	THIS ALTERNATIVE HELPS IMPLEMENT LAND USE AND DEVELOPMENT PATTERN POLICIES. HELPS RETAIN RURAL, AGRICULTURAL LIFE-STYLE OF RESIDENTS OF SITES, AND ENHAND OF SITES, AND ENHAND OFEN SPACES OF PIPELINE ROUTES IN URBAN CORES. 210,000 ACRES OF LAND WITHIN SEVEN SITES ASSURED OF RETENTION AS OPEN SPACE USES. POTENTIAL ORCHARD REPLACEMENT. IN SLUDGE AREAS OF 5,700 ACRES RESULT IN ANNUAL INCOME GAIN OF \$1,122,000.		

NET AVERAGE ANNUAL INCOME LOSS FROM 54,230 ACRES OF CROP CHANGES.

POTENTIAL AGRICULTURAL JOB DISRUPTION FOR 780 WORKERS AND LABOR
INCOME LOSS OF \$1,340,000 PER CROP
CYCLE DUE TO CROP CHANGES. NUISANCE
OF DIRT, DUST, NOISE AND ACCESS DISRUPTION DURING CONSTRUCTION PHASE
MAY CAUSE POSSIBLE BUSINESS AND SERVICE
ESTABLISHMENT LOSSES. POTENTIAL ALTERATION OF JOB DEMAND FOR AGRICULTURAL
MIGRANT WORKERS.

CONCERN OF SYSTEM EFFECT TO POSSIBLY INFLUENCE INRREASED URBANIZATION, ENVIRONMENTAL IMPAIRMENT, CHANGE OF LIFE-STYLE,
CHANGE OF FARM OPERATION AND INCOME,
DISRUPTION OF RESIDENT JOBS AND HOUSING
AND WASTEWATER NUISANCES, INCONVENIENCE
OF PATRONS, SERVICE USERS, AND RESIDENTS
DURING CONSTRUCTION PHASES, ANXIETY
OVER POSSIBLE LOSS OF SOCIAL STRUCTURE
AND COHESION AMONG GONE ETHNIC GROUPS,
CONCERN OF BUSINESS AND SERVICE ESTABLISHMENTS OVER ACCESS DISRUPTION.

NOT APPLICABLE

LANDS. WITH PROPER WATER MANAGEMENT AND ABATEMENT MFASURES THE MAGNITUDE OF THIS VECTOR CONTROL, UNDER THIS ALTERNATIVE ABOUT 50,000 MORE ACRES OF LAND THAN IN ALTERNATIVE BI WOULD BE SUSCEPTIBLE TO WILL INCREASE ARTHROPOD AND VERTEBRATE AREAS A POTENTIAL FOR ZOONOTIC DISEASE LACOONS MAY BE THE MOST HAZARDOUS COM-THE RISK FACTOR THE APPLICATION OF WASTEWATER TO LAND NUISANCE ANIMALS ASSOCIATED WITH WET-INCREASE WILL BF FOUAL TO THAT OF A HABITAT, VECTORS, HOSTS AND AGENTS WILL BE PRESENT IN THE APPLICATION TRANSMISSION WILL EXIST, AERATION WILL DEPEND ON HUMAN EXPOSURE AND NORMAL IRRIGATION PROJECT. SINCE PONENT OF THE SYSTEM. THESE IMPACTS.

	SOCIAL EVALUATIO	SOCIAL EVALUATION -ALTERNATIVE D-2	0-2
	(BENE	FICIAL)	
AREA VIABILITY	PUBLIC ATTITUDES	DISTRIBUTIVE EQUITY	PUBLIC HEALTH
HHIS ALTERNATIVE HELPS IMPLEMENT LAND USE AND DEVELOPMENT PATTERN POLICIES. HELPS RETAIN RURAL, AGRICULTURAL LIFE- STYLE OF RESIDENTS OF SITES, AND EN- HANCES NEICHBORSHOOD COHESION WITH PARKS AND OPEN SPACES OF PIPELINE ROUTES IN URBAN CORES, 209,000 ACRES OF LAND WITHIN SEVEN SITES ASSURED OF RETENTION AS OPEN SPACE USES, POTENTIAL RRCHARD REPLACEMENT IN SLUDGE AREAS OF SA,700 ACRES RESULT IN ANNUAL INCOME	ASSURANCE OF MEETING ADEQUATE WASTEWATER QUALITY STANDARDS. POSITIVE REACTION TO ASSURANCE OF SYSTEM TO HELP RETAIN OPEN SPACE USES ON SITES AND ENVIRONMENTAL ENHANCEMENT OF POTENTIAL PARKS, OPEN SACE, AND RESERVOIRS. SOME EXPRESSION OF AGRICULTURAL BENEFITS FROM OFFICIALS AND INDIVIDUALS IN SAN JOAQUIN, MARIN AND NAPA COUNTIES.	30 MILLION MAN DAYS OF TOTAL CONSTRUCTION EMPLOYMENT; \$1,725 MILLION TOTAL WAGES, \$276 MILLION OF WHICH IS MINORITY SHARE. 7,000 - 9,000 EMPLOYMENT FORCE FOR SYSTEM MILLION. OPPORTUNITY FOR INCREASED SHARE OF MINORITY WORKERS IN JOB TRAINING, AND JOB LEVELS, JOB PARTICIPATION, AND JOB INCOME FOR BOTH CONSTRUCTION AND ORM PHASES.	THE TREATMENT PLANT COMPONENT APPROACHES THE BEST PRACTICABLE TREATMENT TECHNO- LOGY FOR REMOVAL DF TOXIC CHEMICALS. THE LAND TREATMENT COMPONENT WOULD REDUCE THE NUMBER OF WATERBORNE PATHOGENS ENTERING THE ESTUARY UNDER NORALL OPERATING CONDITIONS, GREATER CONTROL OF WATERBORNE PATHOGENS IN EMERCENCY CONDITIONS, A REDUCTION IN THE OVERALL DISCHARGE OF TOXIC CHEMICALS AND A RE- DUCTION IN CHLORINE TOXICITY IN THE ESTUARY, THE SIGNIFICANT REDUCTION OF TOXIC CHEMICALS IN THE RECEIVING WATER WOULD AID NATURAL PROCESSES IN FLUSHING TOXICANTS FROM ESTUARINE SEDIMENTS.
			THIS ALIEKNATIVE PROVIDES FOR NO DISCHARGE OF HEAVY METALS INTO THE CENTRAL BAY AND SUISUN BAY AND ONLY SMALL AMOUNTS (50 lbs/day) INTO THE DELTA.
	(DETRIMENTAL	ENTAL)	
NET AVERAGE ANNUAL INCOME LOSS FROM 54,230 ACRES OF CROP CHANGES. POTENTIAL AGRICULTURAL JOB DISRUPTION FOR 780 WORKERS AND LABOR INCOME LOSS OF \$1,340,000 PER CROP CYCLE DUE TO GROP CHANGES. NUISANCE OF DIRT, DUST, NOISE AND ACCESS DISRUPTION DURING CONSTRUCTION PHASE CAUSING POSSIBLE BUSINESS AND SERVICE ESTRALISHMENT LOSSES. POTENTIAL ALTERATION OF JOB DEMAND FOR AGRICULTURAL MIGRANT WORKERS.	CONCERN OF SYSTEM EFFECT TO POSSIBLY INFLUENCE INCREASED URBANIZATION, ENVIRONMENTAL INDAIRMENT, CHANGE OF LIFE-STYLE, CHANGE OF FARM OPERATION AND INCOME, DISRIPTION OF RESIDENT JOBS AND HOUSING AND WASTEWATER NUISANCES, INCONVENIENCE OF PATRONS, SERVICE USERS, AND RESIDENTS DURING CONSTRUCTION PHASES. ANXIETY OVER POSSIBLE LOSS OF SOCIAL STRUCTURE AND CORPSION AMONG DISRUFTION.	NOT APPLICABLE	ALTHOUGH THE TREATMENT PLANT COMPONENT WILL REDUCE TOXIC CHEMICALS TO LEVELS BELOW BASE LEVELS IT WILL NOT MAINTAIN THOSE LEVELS PAST 2000. THE APPLICATION OF WASTEMATER TO LAND WILL INCREASE ARTHROPOD AND VERTEBRATE NUISANCE ANIMALS ASSOCIATED WITH WETLANDS. WITH PROPER WATER MANGERENT AND ABATEMENT PROPER WATER MANGERENT AND ABATEMENT PROPER WATER MANGERENT AND ABATEMENT WILL BE EQUAL TO THAT OF A NORMAL IRRIGATION PROJECT. SINCE HABITAT, VECTORS, HOSTS AND AGENTS WILL BE PRESENT IN THE APPLICATION AREAS A POTENTIAL FOR ZONOVIC DISEASE TRANS- MISSION WILL EXIST. AERATON LAGOONS MAY BE THE MOST HAZARDOUS COMPONENT OF THE SYSTEM. THE RISK FACTOR WILL DEPEND ON HUMAN EXPOSUPE AND VECTOR CONTROL. UNDER THIS ALTERNATIVE ABOUT 50,000 MORE ACRES OF LAND THAN IN ALTER- IMPACTS.

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1-3	PUBLIC HEALTH	THE TREATMENT PLANT COMPONENT APPLIES THE BEST PRACTICABLE TREATMENT TECHNOLOGY FOR REMOVAL OF TOXIC CHEMICALS. AS A RESULT OF THE LAND TREATMENT COMPONENT OF THE ALTERNATIVE THERE WOULD BE AN OVERALL REDUCTION IN THE NUMBER OF WATERBORNE PATHOGENS IN EMERGENCY CONDITIONS, GREATER CONTROL OF WATERBORNE PATHOGENS IN EMERGENCY CONDITIONS, A REDUCTION IN EMERGENCY CONDITIONS, A REDUCTION IN THE ESTUARY. THE SIGNIFICANT REDUCTION OF TOXIC CHEMICALS AND A REDUCTION IN CHLORINE TOXICITY IN THE ESTUARY. THE SIGNIFICANT REDUCTION OF TOXIC CHEMICALS IN THE RECEIVING WATER WOULD AID NATURAL PROCESSES IN FLUSHING TOXICANTS FROM ESTUARN ESDIMENTS. THIS ALTERNATIVE PROVIDES THE LOWEST DISCHARGE OF TOXIC CHEMICALS TO THE SOUTH BAY AND NO DISCHARGE OF GROSS HEAVY METALS (GHM) TO CENTRAL BAY AND NO		THE APPLICATION OF WASTEWATER TO LAND WILL INCREASE ARTHROPOD AND VERTEBRATE LANDS, WITH PROPER WATER MANGEMENT AND ABATEMENT MEASURES THE MACNITUDE OF THIS INCREASE WILL BE EQUAL TO THAT OF A MORMAL IRRIGATION PROJECT, SINCE HABITAT VECTORS, HOSTS AND AGENTS WILL BE PRESENT IN THE APPLICATION AREAS A POTENTIAL FOR ZOONOTIC DISFASE TRANS- MISSION WILL EXIST, AERATION LAGOONS MAY BE THE MOST HAZARDOUS COMPONENT OF THE SYSTEM, THE RISK FACTOR WILL DEPEND ON HUMANN EXPOSURE AND VECTOR CONTROL. THIS ALTERNATIVE REQUIRES THE MOST LAND OF ANY ALTERNATIVE AND WILL BRING THESE IMPACTS TO LAND AREA 27.	80 3011013
SOCIAL EVALUATION -ALTERNATIVE D-3	DISTRIBUTIVE EQUITY	40 MILLION MAN DAYS OF TOTAL CONSTRUCTION EMPLOYMENT; \$2,277 MILLION TOTAL WAGES, \$364 MILLION OF WHICH IS MINORITY SHARE. 7,000 - 9,000 EMPLOYMENT FORCE FOR SYSTEM OAM, WITH TOTAL ANNUAL WAGES OF \$139 MILLION, OPPORTUNITY FOR INCREASED SHARE OF MINORITY WORKERS IN JOB TRAINING, HIGHER INCOME FOR BOTH CONSTRUCTION AND JOB PHASES.	ENTAL)	NOT APPLICABLE	
SOCIAL EVALUATIO	PUBLIC ATTITUDES	ASSURANCE OF MEETING ADEQUATE WASTEWATER QUALITY STANDARDS. POSITIVE REACTION TO ASSURANCE OF SYSTEM TO HELP RETAIN OPEN STAGE USES ON SITES AND EWVIROMMENTAL ENHANCEMENT OF POTENTIAL PARKS, OPEN SPACE, AND RESERVOIRS. SOME EXPRESSION OF AGRICULTURAL BENEFITS FROM OFFICIALS AND INDIVIDUALS IN SAN JOAQUIN, MARIN BIN NAPA COUNTIES.	(DETRIMENTAL	CONCERN OF SYSTEM FFECT TO POSSIBLY INFLUENCE INCREASED URBANIZATION, ENVIRONMENTAL IMPAIRMENT, CHANGE OF LIFE-STYLE, CHANGE OF FARM OPERATION AND INCOME, DISRUPTION OF RESIDENT JOBS AND HOUSING AND MASTEWATER NUISANCES. INCONVENIENCE OF PATRONS, SERVICE USERS, AND RESIDENTS DURING CONSTRUCTION PHASES. ANXIETY OVER POSSIBLE LOSS OF SOCIAL STRUCTURE AND COHESION AMONG SOCIAL STRUCTURE AND COHESION AMONG SOCIAL STRUCTURE AND COHESION AMONG SOCIAL STRUCTURE ESTABLISHMENTS OVER ACCESS DISRUPTION. OPPOSITION TO THE INTERBASIN TRANSFER OF WASTEWATER.	The second secon
S	AREA VIABILITY	THIS ALTERNATIVE HELPS IMPLEMENT LAND USE AND DEVELOPMENT PATTERN POLICIES. HELPS RETAIN RURAL, AGRICULTURAL LIFESTYLE OF RESIDENTS OF SITES, AND ENHANCES NEIGHBORHOOD COHESION WITH PARKS AND OPPEN SPACES OF PIPELINE ROUTES IN URBAN CORES. 250,000 ACRES OF LAND WITHIN EIGHT SITES ASSURED OF RETENTION AS OPEN SPACE USES. POTENTIAL ORCHARD REPLACEMENT IN SLUDGE AREAS OF 6,000 ACRES RESULT IN ANNUAL INCOME GAIN OF \$1,194,000.		NET AVERAGE ANNUAL INCOME LOSS FROM 69,380 ACRES OF CROP CHANGES. POTENTIAL ACRICULTURAL JOB DIS- COME LOSS OF \$1,730,000 PER CROP CYCLE DUE TO CROP CHANGES. NUISANCE OF DIRT, DUST, NOISE AND ACCESS DISRUPTION DURING CONTRUCTION PHASE MAY CAUSE POSSIBLE BUSINESS AND SERVICE ESTABLISH- MENT LOSSES. POTENTIAL ALTERATION OF JOB DEWAND FOR ACRICULTURAL MIGRANT WORKERS.	

TIVE B-1 PUBLIC FINANCE	PRESERVES AND MAY ULTIMATELY ENHANCE LONG-TERM VALUE OF RIPARIAN LAND THRU REVERSAL OF WATER QUALITY DEGRADATION. THIS MAY INCREASE TAX BASE.		
ECONOMIC EVALUATION - ALTERNATIVE B-1 (BENEFICIAL) S PRODUCTION PUE	BASED ON A PROJECTION OF 10,000 ACRES OF PRODUCING OYSTER BEDS IN THE SAN FRANCISCO BAY ESTUARY, THERE WOULD BE A POTENTIAL FOR AT LEAST 25 MILLION POUNDS PER YEAR OF UNSHUCKED OYSTERS.	(DETRIMENTAL)	
ECONOMIC	NOT APPLICABLE		

THE FOTAL AVERAGE ANNUAL COST FOR THIS ALTERNATIVE WITH REUSE IS \$447,000,000. A MAJOR PART OF THIS COST WOULD BE PROVIDED BY THE FEDERAL GOVERNMENT.
FOR THE BAY-DELTA REGION POPULATION, PER CAPITA LOCAL ANNUAL COSTS WOULD BE APPROXIMATELY \$33
BASE CONDITION.

THE APPLICATION AREAS TO BE USED BY THIS ALTERNATIVE ARE CURRENTLY PRIMARILY IN AGRICULTURAL USE. THE IMPLEMENTATION OF THE ALTERNATIVE WOULD NOT ELIMINATE AGRICULTURAL USE, BUT MOULD REQUIRE CERTAIN CHANGES IN THE CROPS TO BE GROWN TO ACHIEVE A HIGH NITROGEN REMOVAL AND TO AVOID RAISING CROPS FOR DIRECT HUMAN CONSINGATION. IRRIGATION AND FERTILIZER REQUIREMENTS, OF THE CROPS WOULD BE PROVIDED, THEREBY REDUCING COSTS AND EFFECTIVELY INCREASING NET INCOME; ON THE OTHER HAND, THE RESTRICTION OF CROPS AND LOSS OF ALL CROP OUTPUT FOR AN AVERAGE OF TWO YEARS TO ALLOW FOR THE INCOME. FOR THIS ALTERNATIVE THE COMBINED EFFECT OF THESE CHANGES IN AGRICULTURAL PRODUCTION WOULD RESULT IN AN ESTINATED NET AVERAGE ANNUAL INCOME LOSS OF \$673,000.

THE PROPERTY TAX LOSS BASED ON CURRENT TAX RATES FOR PURCHASE OF LANDS USED FOR STORAGE RESERVOIRS, PUMPING STATIONS AND TREATMENT FACILITIES AMOUNTS TO APPROXIMATELY \$165,000 PER YEAR. OF ALL THE LAND APPLICATION ALTERNATIVES, THIS ALTERNATIVE (AND ALTERNATIVE S-2) HAS THE LEAST IMPACT IN TERMS OF LOCAL PROPERTY TAXES.

ATIVE B-2	PUBLIC FINANCE	PRESERVES AND MAY ULTIMATELY ENHANCE LONG-TERM VALUE OF RIPARIAN LAND THRU REVERSAL OF WATER QUALITY DEGRADATION. THIS MAY INCREASE TAX BASE.		THE PROPERTY TAX LOSS BASED ON CURRENT TAX RATES FOR PURCHASE OF LANDS USED FOR STORAGE RESERVOIRS, PUMPING STATIONS AND TREATMENT FACILITIES AMOUNTS TO APPROXIMATELY \$165,000 PER YEAR. OF ALL THE LAND APPLICATION ALTERNATIVES, THIS ALTERNATIVE (AND ALTERNATIVE B-1) HAS THE LEAST IMPACT IN TERMS OF LOGAL PROPERTY TAXES.
ECONOMIC EVALUATION -ALTERNATIVE B-2 (BENEFICIAL)	PRODUCTION	BASED ON A PROJECTION OF 10,000 ACRES OF PRODUCING OYSTER BEDS IN THE SAN FRANCISCO BAY ESTUARY, THERE WOULD BE A POTENTIAL FOR AT LEAST 25 MILLION POUNDS PER YEAR OF UNSHUCKED OYSTERS.	(DETRIMENTAL)	THE APPLICATION AREAS TO BE USED BY THIS ALTERNATIVE ARE CURRENTLY PRIMARILY IN AGRICULTURAL USE. THE IMPLEMENTATION OF THE ALTERNATIVE WOULD NOT ELIMINATE AGRICULTURAL USE, BIT WOULD REQUIRE CERTAIN CHANGES IN THE CROPS TO BE GROWN TO ACHIEVE A HIGH NITROGEN REMOVAL AND TO AVOID RAISING CROPS FOR DIRECT HUMAN CONSUMPTION. IRRIGATION AND FERTILIZER REDUIREMENTS OF THE CROPS WOULD BE PROVIDED, THEREBY REDUING COSTS AND EFFECTIVELY INCREASING NET INCOME, ON THE OTHER HAND, THE RESTRICTION OF CROPS AND LOSS OF ALL CROP OUTPUT FOR AN AVERAGE OF TWO YEARS TO ALLOW FOR THE IMPLEMENTATION OF THE ALTERNATIVE TENDS TO LOWER NET INCOME. FOR THIS ALTERNATIVE THE COMBINED EFFECT OF THESE CHANGES IN AGRICULTURAL PRODUCTION WOULD RESULT IN AN ESTIMATED NET AVERAGE ANNUAL INCOME LOSS OF \$683,000.
ECONOMIC	COSTS	NOT APPLICABLE		THE TOTAL AVERAGE ANNUAL COST FOR THIS ALTERNATIVE WITH REUSE IS \$355,000,000. A MAJOR PART OF THIS COST WOULD BE PROVIDED BY THE FEDERAL GOVERNHENT. FOR THE BAY-DELTA REGION POPULATION, THE PER CAPITA LOCAL ANNUAL COSTS WOULD BE APPROXIMATELY \$26 BY THE YEAR 2000. COSTS ARE INCREMENTAL TO THE BASE CONDITION.

ATIVE B-3	PUBLIC FINANCE	PRESERVES AND MAY ULTIMATELY ENHANCE LONG-TERM VALUE OF RIPARIAN LAND THRU REVERSAL OF WATER QUALITY DEGRADATION. THIS MAY INCREASE TAX BASE.		THE PROPERTY TAX RATE LOSS BASED ON CURRENT TAX RATES FOR PURCHASE OF LANDS USED FOR STORAGE RESERVOIRS, PUMPING STATIONS AND TREATHENT PACILITIES AMOUNTS TO APPROXIMATELY \$189,000 PER YEAR,
EVALUATION -ALTERNATIVE B-3	PRODUCTION	BASED ON A PROJECTION OF 10,000 ACRES OF PRODUCING OYSTER BEDS IN THE SAN FRANCISCO BAY ESTARY, THERE WOULD BE A POTENTIAL FOR AT LEAST 25 MILLION POUNDS PER YEAR OF UNSHUCKED OYSTERS.	(DETRIMENTAL)	THE APPLICATION AREAS TO BE USED BY THIS ALTERNATIVE ARE CURRENTLY PRIMARILY IN AGRICULTURAL USE. THE IMPLEMENTATION OF THE ALTERNATIVE WOULD NOT ELIMINATE AGRICULTURAL USE, BUT WOULD REQUIRE CERTAIN CHANGES IN THE CROPS TO BE GROWN TO ACHIEVE A HIGH NITROGEN REMOVED AND TO AYOLD RAISING CROPS POR DIESCT HYPAYS CONSUMPTION. IRRIGATION AND FENTILIZER REQUIREMENTS OF THE CROPS WOULD BE PROVIDED, THEREBY REDUCING COSTS AND EFFECTIVELY INCREASING MET INCOME; ON THE OTHER HAND, THE RESTRICTION OF CROPS AND LOSS OF ALL CROP OUTPUT FOR AN AVERAGE OF TWO YEARS TO ALLOW FOR THE INCOME. FOR THIS ALTERNATIVE TERDS TO LOWER NET INCOME. FOR THIS ALTERNATIVE TERDS TO LOWER NET INCOME FOR THIS ALTERNATIVE THE COMBINED EFFECT OF THESE CHANGES IN AGRICULTURAL PRODUCTION WOULD RESULT IN AN ESTIMATED NET AVERAGE ANNUAL INCOME LOSS OF \$1,192,000.
ECONOMIC EVA	COSTS	NOT APPLICABLE		THE TOTAL AVERAGE ANNUAL COST FOR THIS ALTERNATIVE WITH REUSE IS \$482,000,000. A MAJOR PART OF THIS GOST WOULD BE PROVIDED BY THE FEDERAL GOVERNWENT. FOR THE BAY-DELTA REGION POPULATION, THE PER CAPITA LOCAL ANNUAL COSTS WOULD BE APPROXIMATELY \$36 BY THE YEAR 2000. COSTS ARE INCREMENTAL TO THE BASE CONDITION.

QUALITY DEGRADATION. THIS MAY INCREASE TAX BASE. PRESERVES AND MAY ULTIMATELY ENHANCE LONG-TERM VALUE OF RIPARIAN LAND THRU REVERSAL OF WATER PUBLIC FINANCE 1-0 EVALUATION -ALTERNATIVE OYSTER BEDS IN THE SAN FRANCISCO BAY ESTUARY, THERE WOULD BE A POTENTIAL FOR AT LEAST 25 MILLION POUNDS PER YEAR OF UNSHUCKED OYSTERS. BASED ON A PROJECTION OF 10,000 ACRES OF PRODUCING (DETRIMENTAL) (BENEFICIAL) PRODUCTION ECONOMIC NOT APPLICABLE COSTS

THE APPLICATION AREAS TO BE USED BY THIS ALTERNATIVE ARE CURRENTLY PRIMARILY IN AGRICULTURAL USE. THE INFLEMENTATION OF THE ALTERNATIVE WOULD NOT ELINGUAL AGRICULTURAL USE, BIT WOULD REQUIRE CERTAIN CHANGES IN THE CROPS TO BE GROWN TO AGRIEVE A HIGH NITROGEN RESOURL AND TO AVOID RAISING CROPS FOR DIRECT HUMAN RESOURL AND TO AVOID RAISING CROPS FOR DIRECT HUMAN

CONSUMPTION. IRRIGATION AND FERTILIZER REGULTRENEYS OF THE CROPS WOULD BE PROVIDED, THEREBY REDUCING COSTINAND EFFECTIVELY INCREASING NET INCOME: ON THE OTHER HAND, THE RESTRICTION OF CROPS AND LOSS OF ALL CROP OUTPUT FOR AN AVERAGE OF TWO YEARS TO ALLOW FOR THE IMPLEMENTATION OF THE ALTERNATIVE TENDS TO LOWER NET INCOME. FOR THIS ALTERNATIVE THE COMBINED EFFECT OF THESE CHANGES IN ACRICULTURAL PRODUCTION WOULD RESULT IN AN ESTIMATED NET AVERAGE ANNUAL INCOME LOSS OF \$684,000.

FOR THE BAY-DELTA REGION POPULATION, THE PER CAPITA LOCAL ANNUAL COSTS WOULD BE APPROXIMATELY \$31 BY

THE YEAR 2000. COSTS ARE INCREMENTAL TO THE BASE

CONDITION.

THE TOTAL AVERAGE ANNUAL COST FOR THIS ALTERNATIVE WITH REUSE IS \$437,000,000. A MAJOR PART OF THIS COST WOULD BE PROVIDED BY THE FEDERAL GOVERNMENT.

THE PROPERTY TAX LOSS BASED ON CURRENT TAX RATES FOR PURCHASE OF LANDS USED FOR STORAGE RESERVOIRS, PUMPING STATIONS AND TREATMENT FACILITIES AMOUNTS TO APPROXIMATELY \$287,000 PER YEAR. THIS ALTERNATIVE HAS A GREATER IMPACT ON LOCAL PROPERTY TAXES THAN THE B SERIES ALTERNATIVES.

ATIVE D-2	PUBLIC FINANCE	PRESERVES AND MAY ULTIMATELY ENHANCE LONG-TERM VALUE OF RIPARIAN LAND THRU REVERSAL OF WATER QUALITY DEGRADATION. THIS MAY INCREASE TAX BASE.		THE PROPERTY TAX LOSS BASED ON CURRENT TAX RATES FOR PUNCHASE OF LANDS USED FOR STORAGE RESERVOIRS, PUMPING STATIONS AND TRRATMENT FACILITIES ANDUNTS TO APPROXIMATELY \$287,000 PER YEAR. THIS ALTERNATIVE HAS GREATER IMPACT ON LOCAL PROPERTY TAXES THAN THE B SERIES ALTERNATIVES.
ECONOMIC EVALUATION -ALTERNATIVE D-2 (BENEFICIAL)	PRODUCTION	BASED ON A PROJECTION OF 10,000 ACRES OF PRODUCING OYSTER BEDS IN THE SAN FRANCISCO BÂY ESTUARY, THERE WOULD BE A POTENTIAL FOR AT LEAST 25 MILLION POUNDS PER YEAR OF UNSHUCKED OYSTERS.	(DETRIMENTAL)	THE APPLICATION AREAS TO BE USED BY THIS ALTERNATIVE ARE CURRENILY PRIMARILY IN AGRICULTURAL USE. THE IMPLEMENTATION OF THE ALTERNATIVE WOULD NOT ELIMINATE AGRICULTURAL USP, BIT WOULD REQUIRE CERRAIN CHANGES IN THE CROPS TO BE GROWN TO ACHIEVE A HIGH NITROGEN REMOVAL AND TO AVOID RAISING CROPS FOR DIRECT HUMAN CONSUMPTION. IRRIGATION AND FERTILIZER REQUIRETENTS OF THE CROPS WOULD BE PROVIDED, THEREBY REDUCING COSTS AND EFFECTIVELY INCREASING NET INCOME: ON THE OTHER HAND, THE RESTRICTION OF CROPS AND LOSS OF ALL CROP OUTPUT FOR AN AVERAGE OF TWO YEARS TO ALLOW FOR THE IMPLEMENTATION OF THE ALTERNATIVE TENDS TO LOWER NET INCOME. FOR THIS ALTERNATIVE THE COMBINED EFFECT OF THESE CHANGES IN AGRICULTURAL PRODUCTION WOULD RESULT IN AN ESTIMATED NET AVERAGE ANNUAL INCOME LOSS OF \$717,000.
ECONOMIC	COSTS	NOT APPLICABLE		THE TOTAL AVERAGE ANNUAL COST OF THIS ALTERNATIVE WITH REUSE IS \$36,000,000. A MAJOR PART OF THIS COST WOULD BE PROVIDED BY THE FEDERAL GOVERNMENT. FOR THE BAY-DELTA REGION POPULATION, THE PER CAPITA LOCAL ANNUAL COSTS WOULD BE APPROXIMATELY \$25 BY THE YEAR ZOOO. COSTS ARE INCREMENTAL TO THE BASE CONDITION.

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TIVE D-3	PUBLIC FINANCE	PRESERVES AND MAY ULTIMATELY ENHANCE LONG-TERM VALUE OF RIPARIAN LAND THRU REVERSAL OF WATER QUALITY DEGRADATION. THIS MAY INCREASE TAX BASE.		THE PROPERTY TAX LOSS BASED ON CURRENT TAX RATES FOR PURCHASE OF LANDS USED FOR STORAGE RESERVOIRS, PUMPING STATIONS AND TREATMENT PACILITIES ANOUNTS TO APPROXIMATELY \$317,000 PER YEAR, THIS ALTERNATIVE HAS GREATEST IMPACT ON LOCAL PROPERTY TAXES.
ECONOMIC EVALUATION-ALTERNATIVE D-3 (BENEFICIAL)	PRODUCTION	BASED ON A PROJECTION OF 10,000 ACRES OF PRODUCING OYSTER BEDS IN THE SAN FRANCISCO BAY ESTUARY, THERE WOULD BE A POTENTIAL FOR AT LEAST 25 MILLION POUNDS PER YEAR OF UNSHUCKED OYSTERS.	(DETRIMENTAL)	THE APPLICATION AREAS TO BE USED BY THIS ALTERNATIVE ARE CHRENITY PRIMARILY IN AGRICULTURAL USE. THE IMPLEMENTATION OF THE ALTERNATIVE WOULD NOT ELIMINATE AGRICULTURAL USE. THE NATIONAL USE TO BE GROWN TO ACHIEVE A HIGH NITROGEN BY THE CROPS TO BE GROWN TO ACHIEVE A HIGH NITROGEN BY THE CROPS TO BE GROWN TO ACHIEVE A HIGH NITROGEN OF THE CROPS WOULD BY PROTILIZER REDUCING COSTS AND EFFECTIVELY INCREASING NET INCOME: ON THE OTHER HAND, THE RESTRICTION OF CROPS AND LOSS OF ALL CROP OUTPUT FOR AN AVERAGE OF TWO YEARS TO ALLOW FOR THE IMPLEMENTATION OF THE ALTERNATIVE THE COMBINED EFFECT OF THESE CHANGES IN AGRICULTURAL PRODUCTION WOULD RESULT IN AN ESTIMATED NET AVERAGE ANNUAL INCOME LOSS OF \$1,230,000.
ECONOMIC	COSTS	NOT APPLICABLE		THE TOTAL AVERAGE ANNUAL COST OF THIS ALTERNATIVE WITH REUSE IS \$472,000,000. A MAJOR PART OF THIS COST WOULD BE PROVIDED BY THE FEDERAL GOVERNBENT. FOR THE BAY-DELTA REGION POPULATION, THE PER CAPITA LOCAL ANNUAL COSTS WOULD BE APPROXIMATELY \$36 BY THE YEAR 2000. COSTS ARE INCREMENTAL TO THE BASE CONDITION.

REQUIRES 995 TONS/DAY OF TREATMENT CHEMICALS, 9,330 MEGAWAIT HOURS/DAY OF POWER, AND 18,900 CUBIC FEET/DAY OF NATURAL GAS. VALUES ARE INCREMENTAL TO THE BASE CONDITION.

NOT APPLICABLE

LAND AREA REQUIREMENTS ARE AS FOLLOWS: 97,000 ACRES FOR WASTEWATER APPLICATION, 48,000 ACRES FOR SLUDGE APPLICATION, 2,150 ACRES FOR LAND TREATMENT FACILITIES, AND 9,300 ACRES FOR WASTEWATER STORAGE PACILITIES.

INSURES OVER 150,000 ACRES OF OPEN SPACE. B-2 USE OF RESOURCES SPECIAL CONSIDERATIONS EVALUATION -ALTERNATIVE (DETRIMENTAL) (BENEFICIAL) \$1,400,000 PER YEAR. RECLAIMS UP TO 125,000 AF/Y OF PURIFIED WATER FOR STREAM FLOW AUGMENTATION, INDUSTRIAL COOLING OR ADDITIONAL IRRIGATION WATER. PROVIDES A SUPPLY OF COOLING WATER ON PROJECT LANDS TO ALLOW SAFE SITING OF CRITICAL INDUSTRIES SUCH AS POWER PLANTS. PROVIDES TREATED WASTEWATER FOR THE IRRIGATION OF '97,000 ACRES. FERTILIZER VALUE DUE TO WASTEWATER AND SLUDGE APPLICATION OF RECLAMATION OF RESOURCES

REQUIRES 160 TONS/DAY OF TREATMENT CHEMICALS, 7,680 MEGAWATT HOURS/DAY OF POWER AND 18,900 CUBIC FEET/DAY OF NATURAL GAS. VALUES ARE INCREMENTAL TO THE BASE CONDITION.

NOT APPLICABLE

LAND AREA REQUIREMENTS ARE AS FOLLOWS: 97,000 ACRES FOR WASTE-WATER APPLICATION, 47,000 ACRES FOR SLUDGE APPLICATION, 2,100 ACRES FOR LAND TREATMENT FACILITIES AND 9,300 ACRES FOR WASTE-WATER STORAGE FACILITIES.

INSURES OVER 190,000 ACRES OF OPEN SPACE. B-3 OF RESOURCES SPECIAL CONSIDERATIONS EVALUATION - ALTERNATIVE USE (DETRIMENTAL) (BENEFICIAL) WATER FOR STREAM FLOW AUGMENTATION, INDUSTRIAL COOLING OR ADDITIONAL IRRIGATION WATER. PROVIDES A SUPPLY OF COOLING WATER ON PROJECT LANDS TO ALLOW SAFE SITING OF CRITICAL INDUSTRIES SUCH AS POWER PLANTS. PROVIDES TREATED WASTEWATER FOR THE IRRIGATION OF 135,000 ACRES. FERTILIZER VALUE DUE TO WASTEWATER AND SLUDGE APPLICATION OF \$1,800,000 PER YEAR. RECLAIMS UP TO 145,000 AF/Y OF PURIFIED OF RESOURCES RECLAMATION

REQUIRES 805 TONS/DAY OF TREATMENT CHEMICALS, 11,510 MEGAWATT HOURS/DAY OF POWER AND 18,900 CUBIC FEET/DAY OF NATURAL GAS. VALUES ARE INCREMENTAL TO THE BASE CONDITION.

NOT APPLICABLE

LAND REQUIREMENTS ARE AS FOLLOWS: 135,000 ACRES FOR WASTE-WATER APPLICATION, 48,000 ACRES FOR SLUDGE APPLICATION 2,150 ACRES FOR LAND TREATMENT FACILITIES AND 10,700 ACRES FOR WASTEWATER STORAGE FACILITIES.

SPECIAL CONSIDERATIONS EVALUATION - ALTERNATIVE D-RESOURCES 0 F ш S 0 (BENEFICIAL) (1) RESOURCE OF RECLAMATION

PROVIDES TREATED WASTEWATER FOR THE IRRIGATION OF 148,000 ACKES.
FERTILIZER VALUE DUE TO WASTEWATER AND SLUDGE APPLICATION OF
\$1,900,000 PER YEAR. RECLAIMS UP TO 230,000 AF/Y OF PURIFIED
WATER FOR STREAM PLOW AUGMENTATION, INNUSTRIAL COOLING OR
ADDITIONAL IRRIGATION WATER. PROVIDES A SUPPLY OF COOLING WATER
SUCH AS POWER PLANTS.

INSURES OVER 210,000 ACRES OF OPEN SPACE.

(DETRIMENTAL)

REQUIRES 765 TONS/DAY OF TREATMENT CHEMICALS, 13,100 MEGAWATT HOURS/DAY OF POWER, AND 20,550 CUBIC FEET/DAT OF NATURAL GAS. VALUES ARE INCREMENTAL TO THE BASE CONDITION.

NOT APPLICABLE

LAND REQUIREMENTS ARE AS FOLLOWS: 148,000 ACRES FOR WASTEWATER APPLICATION, 48,000 ACRES FOR SLUDGE APPLICATION, 2,900 ACRES FOR LAND TREATMENT FACILITIES AND 14,300 ACRES FOR WASTEWATER STORAGE FACILITIES.

0-2 SPECIAL CONSIDERATIONS EVALUATION - ALTERNATIVE

(BENEFICIAL)

RECLAMATION OF RESOURCES

USE OF RESOURCES

PROVIDES TREATED WASTEWATER FOR THE IRRIGATION OF 148,000 ACRES. FERTILIZER VALUE DUE TO WASTEWATER AND SLUDGE APPLICATION OF \$1,900,000 PER YEAR. RECLAIMS UP TO 230,000 AF/Y OF PURIFIED WATER FOR STREAM FLOW AUGMENTATION, INDUSTRIAL COOLING OR ADDITIONAL IRRIGATION WATER. PROVIDES A SUPPLY OF COOLING WATER ON PROJECT LANDS TO ALLOW SAFE SITING OF CRITICAL INDUSTRIES SUCH AS POWER PLANTS.

INSURES OVER 209,000 ACRES OF OPEN SPACE.

(DETRIMENTAL)

REQUIRES 80 TONS/DAY OF TREATMENT CHEMICALS, 11,900 MEGAWATT HOURS/DAY OF POWER, AND 20,550 CUBIC FEET/DAY OF NATURAL GAS. VALUES ARE INCREMENTAL TO THE BASE CONDITION.

NOT APPLICABLE

LAND REQUIREMENTS ARE AS FOLLOWS: 148,000 ACRES FOR WASTEWATER APPLICATION, 47,000 ACRES FOR SLUDGE APPLICATION, 2,900 ACRES FOR LAND TREATMENT FACILITIES AND 14,300 ACRES FOR WASTEWATER STORAGE FACILITIES.

M INSURES ABOUT 250,000 ACRES OF OPEN SPACE. -ALTERNATIVE D-RESOURCE 0 USE SPECIAL CONSIDERATIONS EVALUATION (BENEFICIAL) PROVIDES TREATED WASTEWATER FOR THE IRRIGATION OF 186,000 ACRES, FERTILIZER VALUE DUE TO WASTEWATER AND SUDGE APPLICATION OF \$2,300,000 PER YEAR. RECLAIMS UP TO 250,000 AFY OF PURIFIED WATER FOR STREAM FLOW AUGMENTATION, INDUSTRIAL COOLING OR ADDITIONAL IRRIGATION WATER. PROVIDES A SUPPLY OF COOLING WATER ON PROJECT LANDS TO ALLOW SAFE SITING OF CRITICAL INDUSTRIES SUCH AS POWER PLANTS. OF RESOURCES RECLAMATION

(DETRIMENTAL)

REQUIRES 540 TONS/DAY OF TREATMENT CHEMICALS, 15,800 MEGAWATT HOURS/DAY OF POWER, AND 20,550 CUBIC FEET/DAY OF NATURAL GAS. VALUES ARE INCREMENTAL TO THE BASE CONDITION.

NOT APPLICABLE

LAND REQUIREMENTS ARE AS FOLLOWS: 186,000 ACRES FOR WASTEWATER APPLICATION, 48,000 ACRES FOR SLUDGE APPLICATION, 3,000 ACRES FOR IAND TREATMENT FACILITIES AND 15,800 ACRES FOR WASTEWATER STORAGE FACILITIES.

DISCUSSION

INTRODUCTION

265. This study was conducted in cooperation with, and has had active participation of, Region IX of the Federal Environmental Protection Agency, the State of California Water Resources Control Board, and the appropriate California Regional Water Quality Control Boards pursuant to a joint agreement. The final alternatives developed and evaluated reflect the maximum use of previous studies and underway efforts by Federal, State of California, regional and local agencies. In addition, the general public in the San Francisco Bay and Sacramento-San Joaquin Delta Region and the residents affected in Monterey and San Benito Counties, the latter because of the use of optional Land Site 27, have been kept informed of, and have participated in, the Corps' investigation efforts.

COMPATIBILITY WITH CURRENT STUDIES

266. The State of California, under contract with several consulting engineering firms, presently is developing various wastewater management actions and strategies for basins lying entirely or partially within the San Francisco Bay and Delta Region. These actions and strategies will, by July 1 1975, evolve into the State's "Comprehensive Water Quality Control Plans" as required by State and Federal statutes. Development of the joint agreement, previously cited, indicated that the maximum contribution toward overall planning would be accomplished if this report emphasized the near-future and long-range potential of land application of treated wastewater and a regional approach to the land application of residual solids resulting from wastewater treatment. The six alternatives developed in this study, which emphasize and as a treatment mechanism, do not represent a complete range of possible alternatives but do represent cost effective systems. The land application components are technically comparable in precision level and completeness. Investigations of the State of California have used the data and evaluation factors on land application developed in this report. With the work done by the Corps and that being accomplished by the State, a complete range of alternatives and treatment systems for municipal and industrial wastewater discharges will have been considered by the State of California as is required by Public Law 92-500.

STUDY ASSUMPTIONS AND LIMITATIONS

267. All alternatives developed in this study are comprised of combinations of land application components and conventional sewage treatment plants. Conventional treatment portions were included in the final alternatives since evaluation of earlier alternatives indicated that the most viable systems of wastewater management involving land application would be a combination of both types of improvements. Consideration of conventional treatment also was necessary to develop general data on sources and amounts of treatment system sludge which might be disposed of on land and to develop a range of full system cost; however, the level of precision for convention treatment systems was less than that for land treatment components. Moreover,

considerations regarding the abandonment of about one and one-half billion dollars of existing construction, selected for investment by Federal, State and local governments over other critical urban problems, lead to the judgment that long-range plans should utilize conventional treatment systems to the maximum in areas near the well-defined circulatory patterns of estuarine and ocean waters and in isolated areas not compatible with long-distance transport of wastewater due to combinations of quantity of flow and topography. In the final alternatives treatment plant locations and flow-contributing geographical areas considered for conventional treatment components were defined by least-financial cost mathematical modeling.

- 268. The Corps' study does not address a solution to, or the environmental effects of, combined sewer overflows from the San Francisco and Sacramento collection systems or the problem of urban stormwater runoff in the entire study area. The latter problem could not be addressed because of an inadequate data base. Since San Francisco and Sacramento are making significant progress in solving their local combined sewerage problems and solutions are expected in a near-future timeframe, the State requested that the Corps not address those problems in its study. Also, it was assumed for the Corps' study that no future urbanized area would have combined sewers. The problem of urban stormwater runoff is the subject of recently initiated and future investigations by the Corps to be performed in cooperation with the State of California. The problem is recognized as significant, however, early indications are that solutions may be potentially independent of existing collection and treatment systems.
- 269. Although the State's basin contractors have projected wastewater flows for both dry weather and wet weather conditions, the Corps' study used projected wastewater flows based on average dry weather conditions. The Corps' study assumed that excess infiltration associated with wet weather conditions would be reduced by sewer rehabilitation and/or other flow reduction techniques over the study period. In connection with the Corps' projections, peaking factors were used in designing pumping, conveyance and treatment facilities. The peaking factors used varied between 1.5 and 3.0, depending on localized conditions. The Corps' flows and peaking factors are fairly well aligned with the average dry weather data currently being used in the State's planning studies.

IMPACTS DUE TO CHANGING CONDITIONS

- 270. On 18 October 1972 the "Federal Water Pollution Control Amendments of 1972," (PL 92-500) became law. The law establishes two national goals:
- a. To achieve wherever possible by 1 July 1983 water that is clean enough for swimming and other recreational uses, and clean enough for the protection and propagation of fish, shellfish, and wildlife.
- b. To have by 1985 no discharge of pollutants into the Nation's waters.

- 271. The law also increases Federal aid to help local governments build sewage treatment facilities and sets the following deadlines for actions to control water pollution from industrial and municipal sources.
- a. Industries discharging pollutants into the Nation's waters must use the "best practicable" water pollution control technology by 1 July 1977 and the "best available" technology by 1 July 1983.
- b. All publicly owned treatment works in operation on 1 July 1977 must provide a minimum of secondary treatment.
- c. All publicly owned treatment works must use "best practicable" treatment by 1 July 1983.
- 272. Some regulations necessary for implementation of PL 92-500 are still being finalized and those which have been issued were not available in time to have a major impact on the study. Consequently, the goals and criteria of the Federal legislation are not necessarily reflected in the design of the wastewater management alternatives. However, insofar as possible the water quality provisions of PL 92-500 have been considered in identifying the impacts and characterizing the performance of the final wastewater management alternatives and in their evaluation. Review of assumptions and accomplishments related in the study indicate that all the alternatives would meet the 197 fluent limitation requirements of the law and that Alternative B-3, D-1 and D-3 and the full tertiary system would meet the 1903 water quality requirements.

STUDY RESULTS

- 273. As a result of the Corps' effort in developing and evaluating alternatives for the management of wastewater and sludge by land application techniques, certain important considerations can be highlighted. These considerations have been arranged according to the major items of Corps involvement in wastewater management planning as required by the State-Federal Interagency Agreement discussed earlier and are:
 - a. Land application for the treatment of wastewater.
 - b. Land application for the ultimate disposal of sludge.
 - c. Alternatives for wastewater reclamation and use.
- d. Evaluation encompassing environmental, social and economic considerations.
- 274. CONCERNING THE USE OF LAND APPLICATION FOR THE TREATMENT OF WASTEWATER:

Land application tends to reduce water related urban impacts on the estuarine system. The discharge of pollutants to surface water is lessened.

Both the B-Series and D-Series wastewater management alternatives would eliminate the majority of pollutants (excluding stormwater pollutants) from entering surface waters when compared to the Base Condition.

- -Since the D-Series alternatives contain more land application, less constituents than under the B-Series alternatives would be directly discharged to surface waters.
- -Implementation of any wastewater management alternative would cause temporary disruption of the land sites. However, once the project was completed, this factor would be minimized if not eliminated.
- -The use of land application for wastewater treatment would allow various crops (not necessarily those currently produced) to be grown as a part of the overall renovation process.

With land application, nutrients would be returned to the land where they could be beneficially used by the plants.

The fate of waste materials could be more easily monitored and controlled on land areas.

275. CONCERNING THE USE OF LAND APPLICATION FOR THE ULTIMATE DISPOSAL OF SLUDGE:

Biological sludge contains various components which could be beneficial to agricultural activities.

- -The nitrogen content of sludge would allow its use as a fertilizer supplement.
- -With the use of sludge as a fertilizer supplement, use of commercial fertilizer could be reduced.

The ultimate disposal of sludge could be effectively accomplished at the land sites.

-Since digested sludge would be stored in lagoons for two years, the actual volume of sludge being applied to the land would be about 40 percent of that produced.

Disc harrowing of sludge into the soil would reduce the chance of any sludge being carried from the site by runoff during periods of rainfall.

276. CONCERNING THE RECLAMATION OF RESOURCES AND THE RECOVERY OF TREATED WASTEWATER FOR SUBSEQUENT REUSE:

Treated wastewater would be available as irrigation water; and fertilizer benefits would be realized from the application of wastewater and sludge.

- -Depending on the alternative selected, between 97,000 and 186,000 acres of land could be irrigated.
- -Increased land application, in a manner similar to increased normal irrigation, could increase animal and insect populations. Any final program selected must consider public health factors and include vector control management techniques.
- -Depending on the alternative selected, between \$1.4 and \$2.3 million per year could be realized in fertilizer benefits.

Land-treated wastewater percolating from pastured areas would be available for groundwater recharge.

- -Depending on the alternative selected, between 240,000 and 400,000 acre-feet per year of applied wastewater within the eight land sites would percolate to groundwater.
- -All applied wastewater entering groundwater would be of an acceptable quality; nitrate nitrogen concentrations would be 9 mg/l or below and total dissolved solids concentrations would range from 800 to 1,100 mg/l.
- -The percolation of wastewater would raise the current levels of available groundwater and could also help retard salt water intrusion in coastal areas.

Land-treated wastewater percolating from cropped areas could be recollected in below-ground underdrain systems.

- -Of necessity, ground water aquifers must rise for the underdrains to effectively operate.
- -Depending on the alternative selected, between 125,000 and 250,000 acre-feet per year of recollected water within the eight land sites would be available for reuse from the underdrain systems.
- -Recollected wastewater would be of a quality acceptable for most reuse opportunities; nitrate nitrogen concentrations in the 1-3 mg/1 range are expected and total dissolved solids concentrations would range from 600 to 1,100 mg/1.
- -Recollected wastewater would be available for various modes of reuse such as streamflow augmentation, groundwater recharge, recreation lakes, industrial cooling and further irrigation use.

277. CONCERNING VARIOUS ENVIRONMENTAL EVALUATION CRITERIA:

Both series of wastewater management alternatives would affect wildlife habitats.

- -Some loss of game habitats could result.
- -Due to the beneficial supplemental flows to local streams, enhancement of other more important habitats could occur.

Significant historical, archeological and geological features, with proper design of a system, would not be adversely affected by the land application of wastewater. However, preproject surveys should be initiated.

- -Extensive landscaping included in the design of the alternatives would insure there would be no overall lowering of aesthetic values.
- -Buffer zones could be established to insure no adverse effects on historical and populated sites.

Opportunities for public recreation would be increased.

- -Reservoirs for recollected water could be made available at the land application sites for boating, camping and picnicking.
- -Streamflow augmentation could be expected to enhance fishing and hunting areas.
- -Land application provides the opportunity for increasing open space which could be used for mini-parks.

278. CONCERNING VARIOUS SOCIAL EVALUATION CRITERIA:

Implementation of a wastewater management alternative would provide the increased opportunity for various job careers within the region.

- -The construction of a wastewater management alternative could provide numerous jobs and increased incomes for both individuals and communities.
- -The annual operation and maintenance of a wastewater management alternative could provide millions of dollars of income with the region.

The alternatives suggested tend to integrate urban and rural communities and the impact on rural communities should be carefully evaluated to insure a maximum beneficial program.

-Monterey and Yolo County interests voiced strong opposition to the use of land areas in their counties for the application of wastewater and sludge.

-In addition, Monterey County residents felt that wastewater should not be transported into their area from the San Francisco Bay-Delta Region.

-There was some expression of resulting agricultural benefits from individuals and officials in San Joaquin, Marin and Napa Counties.

279. CONCERNING VARIOUS ECONOMIC CRITERIA:

Regional alternatives with land application components, designed for year 2000 waste loads could cost between \$2.0 and \$3.3 billion. First costs are incremental to Base Condition facilities. Average annual costs could range from \$355 to \$482 million.

Because of waste treatment requirements and contraints with respect to agricultural activities, and crop losses during program implementation, average annual agricultural income loss could range between \$673,000 and \$1,230,000. However, by the year 2000 some of the alternatives show an income gain, in some instances as high as \$691,000, derived primarily from system-provided fertilizer supplement and water.

Even with the "use contact" concept for the acquisition of major land needs, some property tax loss would occur for purchased lands. This loss could range from \$165,000 to \$317,000.

Some offsetting benefits would occur with the use of land application alternatives such as:

-The potential for reclamation of resources.

-The possibility of locating critical industries near wastewater storage lagoons. This latter aspect could increase the local tax base.

-The potential for increased oyster production in the San Francisco Bay Estuary.

degional alternative with land application components could also produce non-quantifiable benefits such as open space and new water supplies.

TURE REQUIREMENTS

280. Detailed plans for agricultural operation on crop and pasturelands have not been addressed in this study. It was felt that such discussions were premature until a basic land application plan was selected. If and when the detailed designs for land treatment systems are undertaken, the following items must be addressed in detail.

- a. Special farm management techniques such as terracing practices, pesticide application and optimum fertilizer schedules.
 - b. Irrigation schedules.
 - c. Crop patterns including planting and harvesting schedules.
- d. Education of the land owners on the proper operation and maintenance of land application systems.
- 281. Other issues must be considered in more detail before large-scale land treatment systems are implemented. Such items include the extent of heavy metal translocation from the soil to vegetation due to wastewater and sludge application; exact nitrogen removal percentages by various crops under programmed growth patterns; and, the final total dissolved solids content expected when the steady state condition for land treatment is achieved. Pilot plant programs and/or monitoring of existing land application systems appear to be the logical preparatory step to final implementation of a large-scale land application wastewater management alternative.

CONCLUSIONS

- 282. As a result his study, the Corps has made the following conclusions concerning the feasibility of the development of land application alternatives for wastewater management on a regional basis:
- a. The development of land application alternatives for wastewater management on a regional basis is feasible and could produce an effluent comparable to tertiary treatment.
- b. The ultimate disposal of sludge could be accomplished through the use of land application.
- c. Through the use of land application, a valuable resource, reclaimed water, could be recovered and beneficially used for various enhancement purposes.
- d. No major socio-ecological or economic factors have been identified which would negate wastewater management by land application.

RECOMMENDATIONS

- 283. Two regional wastewater management concepts incorporating land application, each including three separate alternatives for municipal and industrial discharges, have been described and evaluated in this report. It is evident that land application techniques for treating wastewater offer a viable alternative means of meeting Federal and State water quality objectives and goals for many areas of the 12-county San Francisco Bay and Sacramento-San Joaquin Delta Region. Therefore, based on the work accomplished in this study and its resultant conclusions, it is recommended that the Corps of Engineers:
- a. Provide technical assistance to the State of California on land treatment systems for the disposal of municipal and industrial effluents, as requested, in completing and/or updating Comprehensive Water Quality Control Plans for basins within the San Francisco Bay and Sacramento-San Joaquin Delta Region;
- b. Continue and expand, under the original study authorization and in cooperation with the State of California and the Environmental Protection Agency, data collection and analysis of non-point sources of pollution including urban stormwater runoff; and,

c. Be authorized to prepare, in cooperation with the State of California and its local governmental bodies, subregional feasibility reports on land treatment of municipal, industrial, and non-point discharges in the 12-county San Francisco Bay and Sacramento-San Joaquin Delta Region with the objectives being consistent with comprehensive policies and plans for water quality.

H. A. FLERTZHEIM, JR.

Colonel, &E

District Engineer

STUDY PARTICIPATION GROUPS

- A. LAWRENCE BERKELEY LABORATORY (through the Atomic Energy Commission) Information was provided on industrial flow and constituent projections.
 - B. PBQ&D, INC Provided data on the following subjects:

Land site identification and evaluation.

Wastewater application to land.

Land site development and environmental assessments.

Sludge and residual solids characteristics, treatment, and transportation.

Disposal of sludge by various land application methods.

Environmental impact assessments for the representative land sites.

Special consultant reports in the following areas:

JONES AND STOKES ASSOCIATES, INC. - Criteria and considerations for the selection and evaluation of wastewater application sites; preliminary survey of wastewater application sites.

HARDING, MILLER, LAWSON & ASSOCIATES - Wastewater land site identification; soil, geology and groundwater studies.

STONE AND ASSOCIATES - Sewage effluent disposal through utilization by tree covered ecosystems.

SAN FRANCISCO BAY MARINE RESEARCH CENTER, INC. - Environmental considerations.

KENNEDY ENGINEERS, INC. - Water quality and public health criteria.

SEQUOIA GROUP, BERKELEY - Public health considerations at the representative land sites.

DRS. J. W. BIGGAR AND J. N. LUTHIN - Land and water quality, and irrigation and drainage.

C. BERKELEY PLANNING ASSOCIATES - Social well-being considerations.